DEVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

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COMING SOON

An interesting article on the use of radio-isotopes in the development and evaluation of metal cleaners.

The story of a new, hard coating for aluminum alloys that gives better wear resistance than chrome plate.

A story on the way one large plant has set up and operates a production electropolishing operation on stainless steel parts.

A new chromizing method that gives bright, lustrous coatings resembling decorative electroplated chrome deposits.

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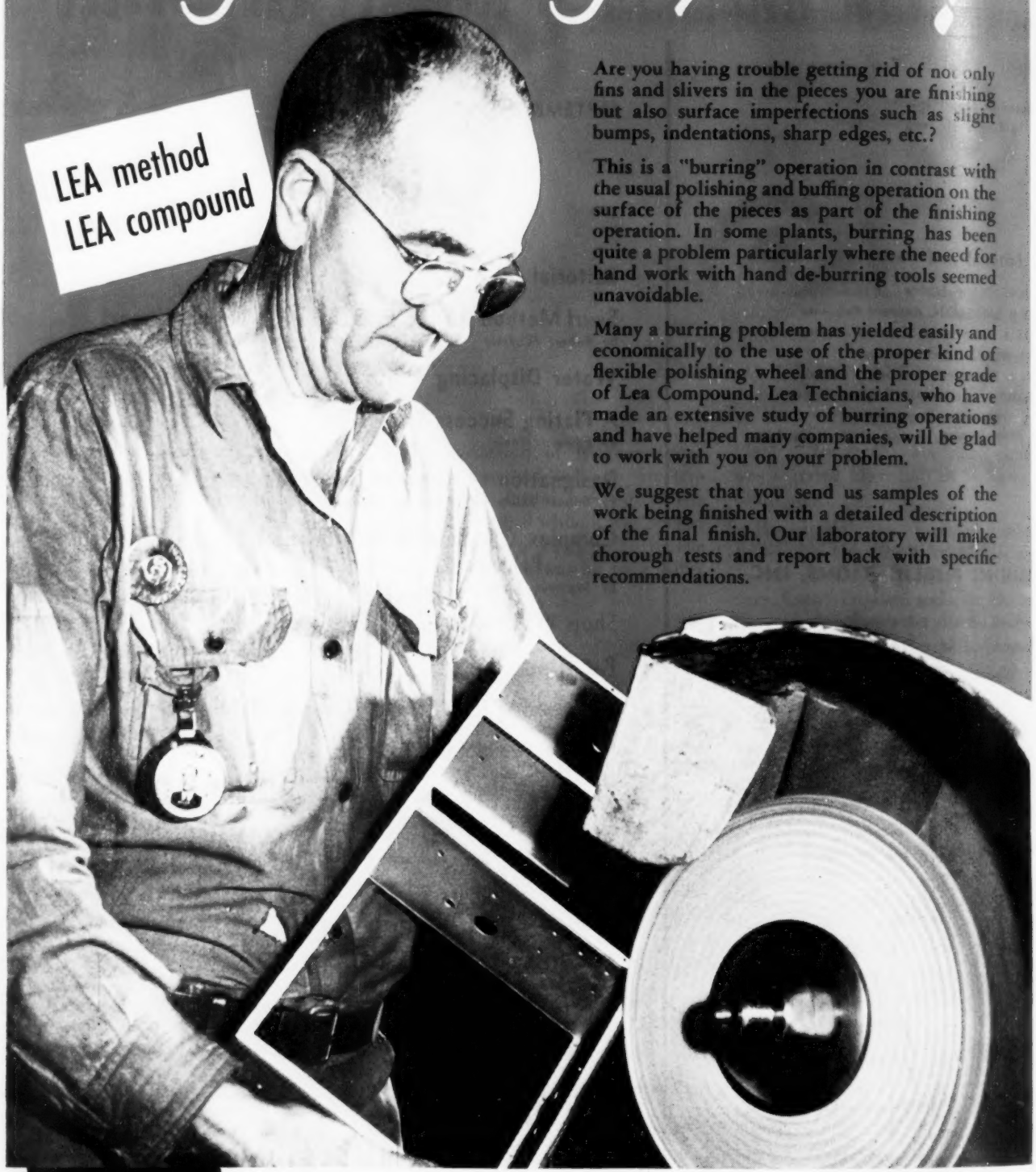
Burring...don't let it get you down!



Are you having trouble getting rid of not only fins and slivers in the pieces you are finishing but also surface imperfections such as slight bumps, indentations, sharp edges, etc.?

This is a "burring" operation in contrast with the usual polishing and buffing operation on the surface of the pieces as part of the finishing operation. In some plants, burring has been quite a problem particularly where the need for hand work with hand de-burring tools seemed unavoidable.

Many a burring problem has yielded easily and economically to the use of the proper kind of flexible polishing wheel and the proper grade of Lea Compound. Lea Technicians, who have made an extensive study of burring operations and have helped many companies, will be glad to work with you on your problem.

We suggest that you send us samples of the work being finished with a detailed description of the final finish. Our laboratory will make thorough tests and report back with specific recommendations.

Burring, Buffing and Polishing . . . Manufacturers and Specialists in the Development of Production Methods, Equipment and Compositions

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Something Old - Something New

With the experience of a half a dozen years of extensive industrial experience as a background, the various good and bad points about bright nickel plating, the "glamour girl" of the industry, are gradually being pieced together. The optimistic thought that the advent of bright nickel sounded the death-knell for dull nickel plating has to be tempered in the light of recent knowledge of the shortcomings of bright nickel.

While it was recognized at an early stage that bright deposits generally were more brittle and subject to internal stresses, more recent research also indicates that the bright deposits are more permeable, less protective to the base metal under certain corrosive conditions (the latter probably being another way of stating the former), have less ability to fill up minute surface defects (microthrow and levelling), and are generally less suitable for complex shaped parts where some touch-up color buffing is necessary. While these facts must affect a modification in the original optimism for bright nickel, they in no way nullify the tremendous practical and economic advantages of the process, serving only to more accurately define the relation of the process to the overall field of electrodeposited coatings.

On the other hand, we are also discovering that one of the old and often neglected work-horses of the industry, acid copper plating, has some heretofore unappreciated properties, and may yet turn out to be the "Cinderella" of plating. The recently-proven superior micro-throwing power of acid copper baths should affect renewed interest and increased applications for it, although something to overcome immersion deposition still must be found if the pumpkin is to be turned into a golden chariot.

Such is the path of progress—fitting the new and old together into a pattern reflecting accurately the fields of maximum utility of each.

W. A. Raymond

Editor

Swirl Method for the Evaluation of Metal Cleaners

By Robert H. Tiers, *Research and Development Div., Pennsylvania Salt Mfg. Co.*

A REVIEW of many of the known methods for testing and evaluating alkaline cleaners has indicated that a meaningful gravimetric method is sorely needed. The accuracy of present commonly used methods is open to question, as most of our practical performance tests depend on a visual comparison of a test specimen with a standard. All too frequently the standard exists only in the memory of the test operator. It borders on the impossible, then, to make reliable and indisputable records of test results, and evaluation of a cleaner becomes a matter of judgment on the part of a skilled operator.

A practical gravimetric method eliminates the personal factor inherent in visual tests. The "Swirl" method, described in the following paragraphs, was developed as a possible approach to the need for a gravimetric test method. This method appears promising although, admittedly, considerable additional development work needs to be done before its interpretability and reliability over a wide range of conditions can be assured.

As the test is presently performed, too wide a variance between test specimens may occur. Additional standard soils more representative of shop production soils should be developed. Further work must be done before the method can be used on electrolytic cleaners, although it is relatively simple to electrify the equipment.

Attention is called to the photographs in Figures 1 and 2. The visual appearance of the panels, in some cases, does not coincide with the percentage of soil removal as determined gravimetrically. In particular, in *Figure 1: Cleaner X*, the middle panel appears to have undergone more complete soil removal than the two panels to the left of it. Similarly, in *Figure 2: Cleaner X*, the fouth panel has the appearance of having lost more soil than any of the others. In this test, therefore, as in others, gravimetric data must be preferred to visual observations.

Developing a Standard Soil

Development of a suitable synthetic soil for this test was found to be, as would be expected, a study in itself. There were two primary objectives in the development of the standard soils: (1) the soil should contain as many as possible of the various types of soil commonly encountered in industrial production lines, and (2) the various ingredients of the soil must be of a clearly specified quality and readily obtainable on the open market.

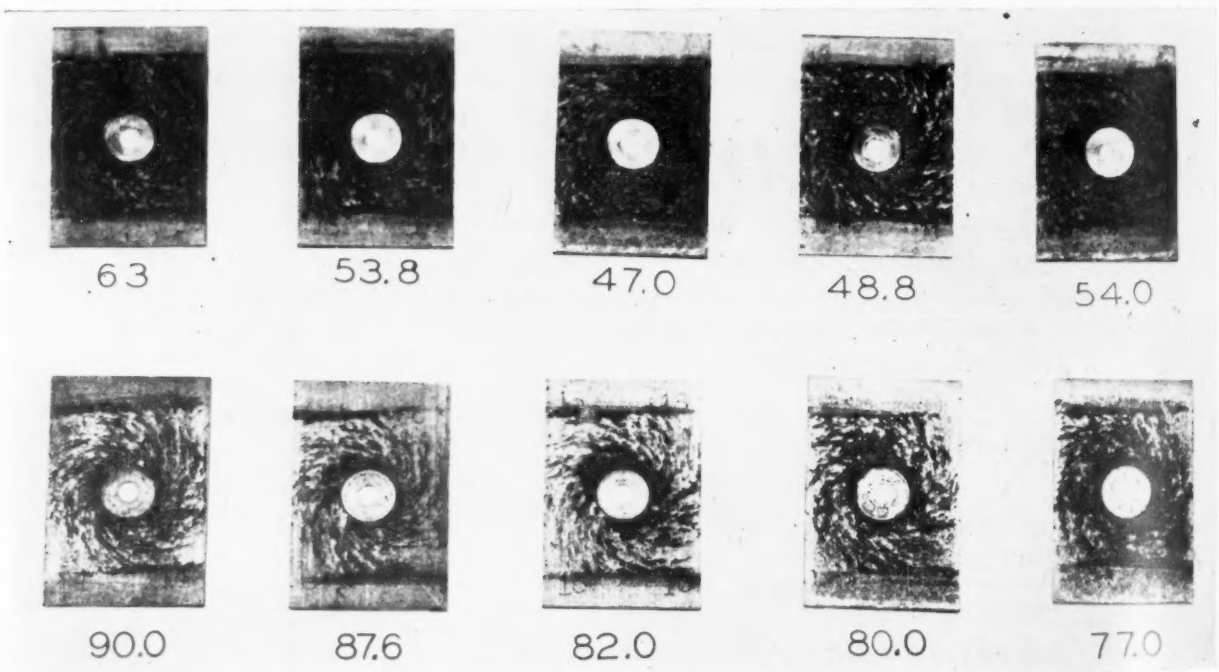

Figure 1. Two sets of (5) panels comparing the efficiency of alkaline cleaners "A" and "X", tested at 180°F. Time of rotation in bath was 3 minutes. The figure under each panel is the percentage of soil removed. Cleaner A removed an average of 53.3 per cent of the soil whereas Cleaner X removed an average of 83.3 per cent in 3 minutes. By varying the period of rotation it is possible to appreciably change the percentage of soil removed, as shown in Figure 2.

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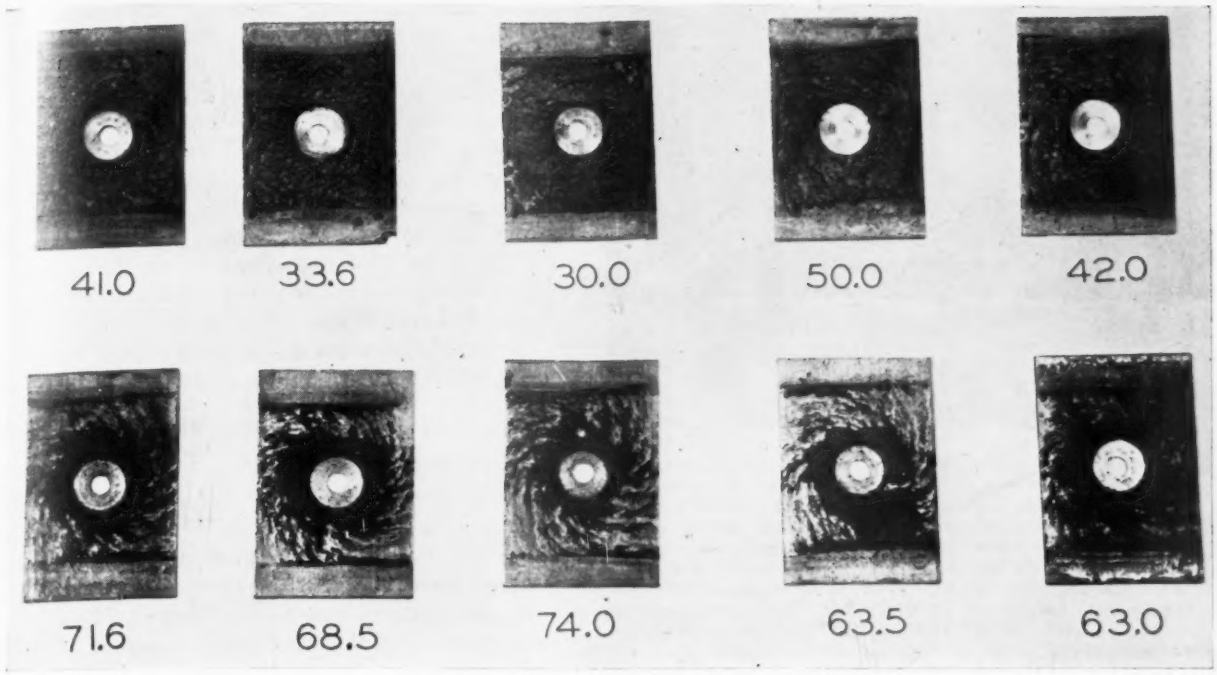

Figure 2. Two sets of (5) panels comparing the efficiency of alkaline cleaners "A" and "X", tested at 180°F. Time of rotation in bath was 1 minute. The figure under each panel is the percentage of soil removed. Cleaner A removed an average of 39.3 per cent of the soil whereas Cleaner X removed an average of 68.1 per cent.

There is an obvious and grave objection to the use of a complex soil containing as components a variety of individual soils. Such a mixture is not typical of anything. Furthermore, the ease of removal of any one component is bound to be affected by the other materials present. It should be emphasized that this procedure is not designed to replace the testing of a cleaner under use conditions; rather it is to provide a first approximation comparison of alkaline cleaners. We have found the method will serve as a basis to predict the relative effectiveness of various cleaners in their usual applications.

The second objective merits careful consideration, since if two or more investigators are to obtain uniform results in any test procedure the soils must be identical. It is believed that *non-uniformity of soil is the greatest single factor contributing to the frequently controversial results obtained* by competent operators using otherwise identical test procedures.

For the purpose of this test it was first of all necessary to have a soil which would be sufficiently tenacious to adhere to the test panels and not flake off, and yet have a consistency permitting easy application to the panels. It was found that a mixture of ceresin wax or paraffin wax and cup grease (*Atlantic Lubricant #64* or *Motor Grease #3*) was satisfactorily adherent. The cup grease had the added advantage of being representative of soils frequently encountered, in that it contains a metallic soap and a large amount of non-saponifiable material. *Hymag* asbestos was added to provide a relatively inert inorganic material. It is this type of soil which is frequently extremely troublesome, as it is almost impossible to penetrate and remove the last traces by chemical treatment alone. Asbestos was chosen over many other materials, as it contributed to the desired consistency and did not flake off the panels. *Bone charcoal* was added to color the soil for ease of observation. The addition of as little as 0.5% of saponifiable material to the soil formula greatly affects the relative ease of removal. *Indusoil*, a refined grade of tall oil, is readily saponified, and by increasing the amount of it in the formula it is possible to compound soils which are quite easy to remove. On the other hand, by omitting all saponifiable matter from the formula and adding, instead, an appreciable amount of a material such as a coal tar (Tarvia), a soil can be made which is extremely tenacious and difficult to remove. Lubricating oil was added to the formula to make the soil more fluid and, of course, provided more non-saponifiable material.

The various ingredients, and the percentage of each ingredient used in a synthetic soil formulation can be varied to meet the degree of stubbornness desired. This, together with the conditions of test (time and temperature) can be varied to bring results into a practical range for comparison, say between 25 and 75% of soil removal. Of course, only 75% soil removal in production cleaning would not be practical, but this should not be confused with the point under discussion. It has been found through many series of tests that when only a very small amount of soil was removed, or when practically all of the soil was removed from the panels, the method was not sufficiently sensitive for the clear cut comparison of two cleaners which have fairly close detergency powers. By increasing or decreasing the tenacity of the soil, or altering the test conditions so that between 25 and 75% of the soil is removed from the panels, accurate comparison of the cleaners is obtained. Frequently increasing or decreasing the time of rotation of the panel by as little as fifteen seconds will bring the test results into the desired range of soil removal. There will also be individual panels which will be unexplainably high or low in percentage of soil removal, and it is for this

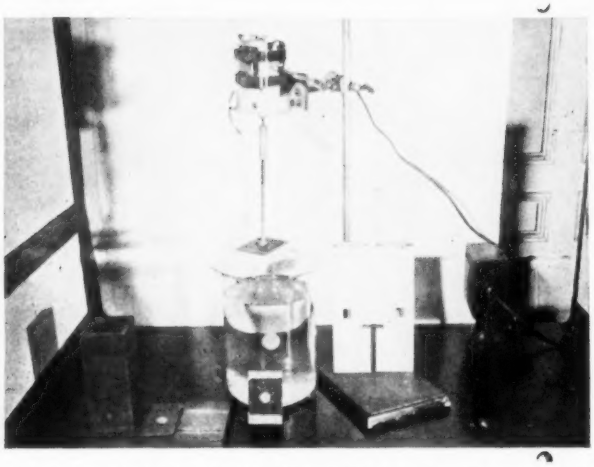

Figure 3. At the top of the photograph is an electric motor with shaft extending downward. Test plate is bolted to motor shaft which turns at 200 RPM. Baffle shown at the right of beaker is inserted vertically in the beaker and test plate rotates through horizontal slot in baffle which virtually eliminates induced circular motion of the solution. In front of the beaker is a typical soiled test panel. At the left is the sliding applicator for applying prepared viscous soils to test panels. The cleaning solutions to be evaluated can be tested at any practical concentration, temperature and period of time. The soil used consisted of: medium cup grease 27.0 g.; SAE 20 Oil 16.0 g.; powdered asbestos 30.0 g.; powdered charcoal 15.0 g.; Indusoil 0.5 g., Ceresin wax 10.0 g., and sufficient carbon tetrachloride to give proper consistency for application (about 33.0 ml.). The panels are held twenty-four hours or warmed in an oven to drive off the carbon tetrachloride before use. This soil formula may be changed to more nearly approach actual production soils.

reason that at least five panels should be run in each cleaning solution tested.

The apparatus, although simple to construct and assemble, is quite critical, since mechanical action has been made to play an important role, as it does in most industrial cleaning operations. Under good test conditions hot distilled water will remove almost half as much soil as a 1% solution of sodium carbonate.

The solution baffle is essential to maintain good mechanical action. Without it the test liquid builds up rotational velocity and the rate of soil removal drops to almost nothing. This baffle consists of a piece of strap metal sufficiently long to rest on both sides of the test breaker, and strong enough to support by a weld a 1/16" thick section of sheet steel divided vertically in the center and notched and spread as shown. When welded in place there is a ½" wide slot running from top to bottom of the baffle. This slot allows the motor shaft to be centered in the baffle during the actual test. There is also a horizontal slot $4\frac{3}{16}$" long by ⅝" high, located just below the center of the baffle. This slot allows for the free passage of the rotating panel. The panel rotating in this slot sets up eddy currents and causes swirling of the solution. The smaller horizontal slot allows space for the nut with which the test panel is affixed to the motor shaft.

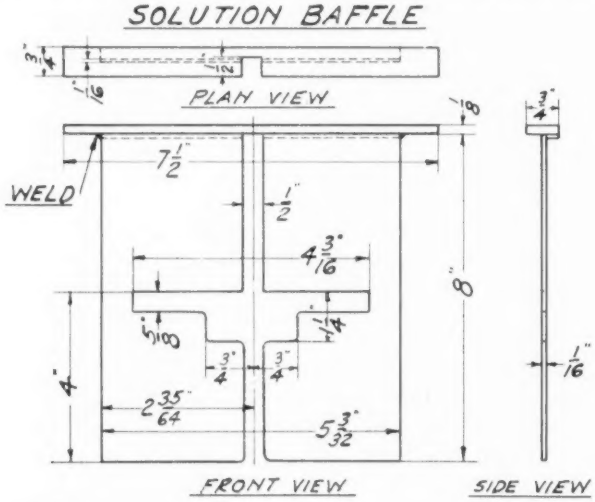

Figure 4. Sketch of the baffle plate used to prevent rotation of the cleaning liquid.

Method for Evaluating Alkaline Cleaners

Principle

Various preparations of soil mixtures are applied to weighed steel panels. After re-weighing the panels plus soil, the panels are attached to a shaft which is rotated by a small motor.* The panels are rotated in a solution of the cleaner to be evaluated. The panels are then removed from the cleaner, rinsed in water, and placed in the oven to dry. Finally, the panels are examined and re-weighed, and the soil weight loss computed in percentage.

Preparation of Soil

Soil preparations for this test must be such that the combination of all the soil constituents produce a solid soil. These soils are made to flow by addition of a solvent such as carbon tetrachloride. This flowability is essential so that the soil can be applied to the panels. Two soil preparations which have been found very satisfactory consist of the following ingredients (All percentages are on a weight basis):

Soil #1

Atlantic Lubricant #64	27.4%
Esso Motor Oil	16.2%
Hymag Asbestos (150 Mesh)	30.5%
Charcoal Bone Powder	15.2%
Indusoil	.5%
Ceresin Wax	10.2%

To every 100 grams of above soil add 34 cc. of CCl_4.

Soil #2

Atlantic Motor Grease #3 (Lime Base Cup Grease)	20.4%
Tarvia NC Barrett Division (Coal Tar)	20.4%
Esso Motor Oil	20.4%
Hymag Asbestos (150 Mesh)	20.4%
Charcoal Bone Powder	12.3%
Paraffin	6.1%

To every 100 grams of above soil add 40 cc. of CCl_4.

Specifications and Preparation of Panels

The panel is made of cold-rolled steel of specifications as indicated in Fig. #7. A metal disc $\frac{1}{16}$" in

*The motor used was a Flexo-Action, 16-1 Ratio, 201 R.P.M. Output, purchased from the Merkle-Korff Gear Co., 213 N. Morgan St., Chicago, Ill.

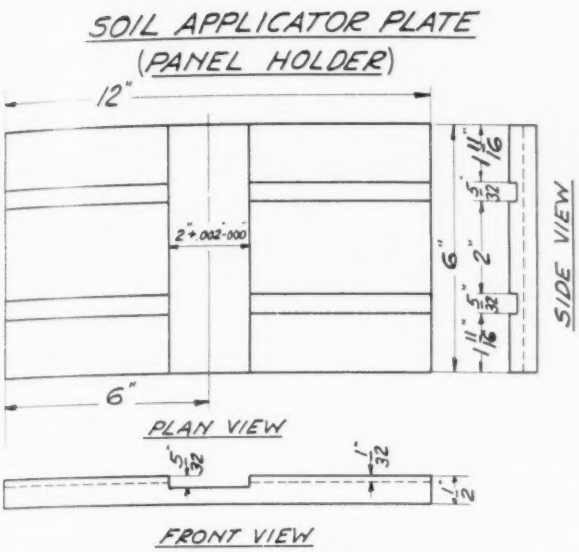

Figure 5. Special plate for holding the test panel while applying soil.

thickness (same dimension as a ten cent piece) is made to fit inside of the counterbored space in the center of the panel.

The panel is submitted to the following cleaning cycle prior to soil application:

1. Remove all soil such as grease, oil and foreign material by soaking in a solvent such as trichlorethylene.
2. Dry.
3. Soak in an alkaline cleaner.
4. Thorough water rinse.
5. Soak in inhibited 1:3 HCl for 3 minutes, at room temperature.
6. Thorough water rinse and dry.
7. Weigh the panel to nearest half tenth of one gram.

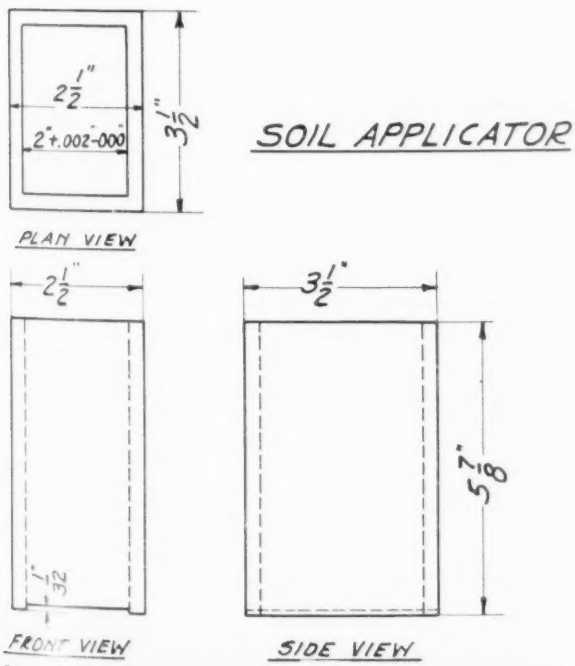

Figure 6. Applicator for applying a constant quantity of soil to the test panel.

Application of the Soil

Correct use of the following apparatus shown in Figures 5 and 6 will enable one to apply approximately 1 gram of soil to the cold-rolled steel panel. The steel panel with fitted disc is placed in the center of the panel track in the panel holder. The applicator is placed on the track on one end of the holder. The soil is poured into the applicator until the soil attains a height of $1\frac{1}{2}$ to 2" in the applicator. The applicator is pushed gently across the panel to the opposite side of the holder: in this way an even coat of soil is applied to the panel.

The panel containing the soil is either placed in an oven at a specified temperature for a specified time, or air dried for a specific time. The method of drying the soil is dependent on the type of soil used. In the case of soil #1, the panel is placed in an oven at 80°C. for twenty minutes. In the case of soil #2, the panel is air dried overnight.

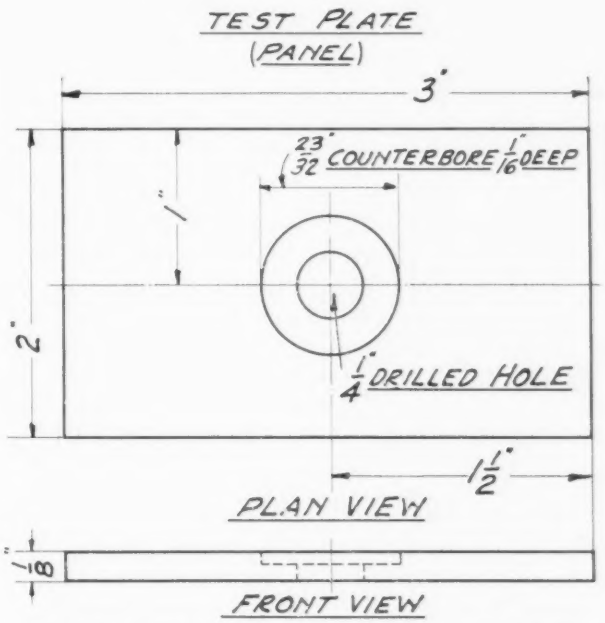

Figure 7. Sketch of the test panel used in these swirl tests.

The small disc is removed from the panel by inverting the panel and pushing the disc out of the recess by inserting a pencil or other sharp object through the $\frac{1}{4}$" drill hole. Small amounts of soil on the edges of the panel are removed by scraping with a spatula and subsequent wiping with a clean cloth being careful not to smear any of the soil on the panel. The panel is next weighed to the nearest half tenth of a gram.

Swirling Operation

Solutions of cleaners to be tested are prepared and maintained at a specified temperature. The soiled panels are attached to the shaft rotated by the small motor at a constant R.P.M. The metal baffle is placed in the beaker containing the cleaning solution. The panel (attached to shaft of motor) is lowered into the cleaning solution by use of a clamp and ring-stand arrangement. The panel is lowered to such a level in the solution that the panel will rotate freely through the opening of the baffle. After rotating the panel for a definite time in the cleaner, the panel is removed, rinsed, and placed in an oven at 80°C. for fifteen

minutes to dry. See Fig. #4 for specifications of metal baffle and Fig. #3. for general illustration.

Determining Efficiency of Cleaner

The panel is removed from the oven and allowed to cool to room temperature. The panel is then weighed. By the following formula, we are able to calculate the percentage of soil removed by the cleaner:

$$\frac{W_1 - W_2}{W_1 - W_p} \times 100$$

W_1 = Initial weight of panel plus soil.
W_p = Weight of panel alone.
W_2 = Weight of panel plus soil after swirling in cleaner and drying.

Comparison of Alkaline Cleaners by the Swirl Test Method

To determine the relative efficiency of cleaners, solutions of known concentration are prepared. Test panels will have previously been prepared as explained above. The actual cleaning operation is then performed by swirling a soiled panel in the solution of the cleaner to be tested. After rinsing, drying and re-weighing the percentage of soil removed is calculated. The cleaner removing the highest percentage of soil is the most efficient.

Following are some typical figures (see below Table I) obtained in the routine comparison of two cleaners called A and X both at a concentration of 5 ounces per gallon. The percentage of soil removed by the two cleaners at both 1-minute rotation (39.3% for A and 68.1% for X, see Figure #2) and at 3-minute rotation (55.3% for A and 83.3% for X, see Figure #1) indicate clearly that X is a more efficient cleaner than A. These figures also show clearly that the conditions of testing (time of rotation) can be varied to bring results of any cleaners within the practical range of this method, i.e. between 25 and 75% of soil removed.

Conclusions

The following conditions in the Swirl Test greatly influence the efficiency of the cleaner in removing the prepared soil:

1. Temperature of cleaning solution.
2. Concentration of cleaning solution.
3. Revolutions per minute of shaft of motor.
4. Time of soiled panel in cleaning solution.

Consequently, in comparing the efficiency of two or more cleaners, all of these conditions must be fixed. One particular set of conditions might give good comparison among mild alkaline cleaners, while another fixed set of conditions will give good comparison among strong alkaline cleaners.

Very satisfactory results, which were reproducible, have been obtained by this test method. This test is both a qualitative and quantitative test. The equipment used is rather inexpensive and easy to handle; with a little practice one will be able to perform the Swirl Test successfully.

Table 1

Typical Figures

	Time of Rotation of Panel in Solution	*Percentage of Soil Removed*
Cleaner A	1 Minute	41
" "	" "	33.6
" "	" "	30
" "	" "	50
" "	" "	42
	Average	39.3
Cleaner A	3 Minutes	63
" "	" "	53.8
" "	" "	47
" "	" "	48.8
" "	" "	54
	Average	53.3
Cleaner X	1 Minute	71.6
" "	" "	68.5
" "	" "	74
" "	" "	63.5
" "	" "	63
	Average	68.1
Cleaner X	3 Minutes	90
" "	" "	87.6
" "	" "	82
" "	" "	80
" "	" "	77
	Average	83.3

The assistance of Messrs. *Alfred H. Pope, Charles W. Hagerman* and *Alfonso Baldi* in the development of the method is gratefully acknowledged.

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Water Displacing Fluids

Although water displacing fluids are already performing valuable service in many branches of industry, their application to metal finishing is still only in its infancy. Platers who have tried using these new materials have found them indispensible in overcoming certain production problems. This article attempts to shed light on this important class of compounds and their application to plating and finishing procedures. —*Ed.*

THE protection of surfaces already wetted by water was a requirement which first arose from war conditions. Thus, in the shipment of aero-engines from the U.S.A. to this country a number were lost by enemy action. Corrosion of these engines on the sea bottom was very slight owing to the lack of available oxygen, but when salvaged and brought to the surface, corrosive attack commenced immediately and could not be easily prevented by the existing conventional protective measures. Another requirement arose from the necessity of removing water from the generators and starter motors of motor vehicles after driving through seawater in landing operations and their protection after the water had been displaced. The problem, then, was to produce a fluid which would displace water from a metal surface and after removal of this water would leave a protective film to prevent subsequent atmospheric corrosion.

A solution of lanolin in white spirit furnishes a film which is protective and easily removable and has been in use for many years as a temporary protective. The first problem was to give it dewatering properties. There are certain surface active materials which will preferentially wet metal surfaces and the incorporation of such a constituent in the lanolin/solvent mixture was tried out with some success. It was found, however, that the speed with which the water was displaced by the fluid was important. If this were too slow, water tended to re-establish itself before the protective film was laid down. A spreading agent was then added and the resultant blend was found to be quite satisfactory as a dewatering protective.

The water displacing action of these fluids can be demonstrated by a very simple experiment. If a small piece of cotton wool thoroughly saturated with water be immersed in a glass vessel containing a dewatering fluid, water immediately starts to separate from the cotton wool and to flow in a continuous stream to the bottom of the vessel. This continues until all the water is removed (Fig. 1 A and B). A similar experiment using a conventional protective such as lanolin/white spirit will show quite conclusively that no separation of water from the cotton wool occurs (Fig. 1 C).

(Reprinted by permission from Electroplating and Metal Finishing — London)

Thus a water displacing fluid consists essentially of a solution in white spirit (or similar solvent) of a film-forming material, a water displacing agent, and a rust inhibitor. On being applied to the metal surface by dipping, brushing or spraying, the solvent evaporates leaving behind a slightly tacky transparent coating which is capable of preventing the rusting of cleaned and pickled steel under normal conditions of indoor exposure for periods of the order of a few days to six months or more depending upon the type and thickness of the "dry" coating. It is not intended that protection should be permanent or sufficient to withstand outside exposure for more than a very limited period. Dipping is the preferred method of application to ensure full coverage. 2,500-3,000 square feet per gallon has been given as an average covering figure for a typical dewatering fluid.

Solvent evaporation (drying) takes place in one to two hours in summer but may take three or four days in winter. This is a disadvantage but if the article can be put through an oven (as used for paint baking, for example) drying time can be reduced to a matter of minutes. The temperature of such an oven should not be too high or the protective coating is melted. The maximum safe temperature for one well-known range of water displacing fluids is around

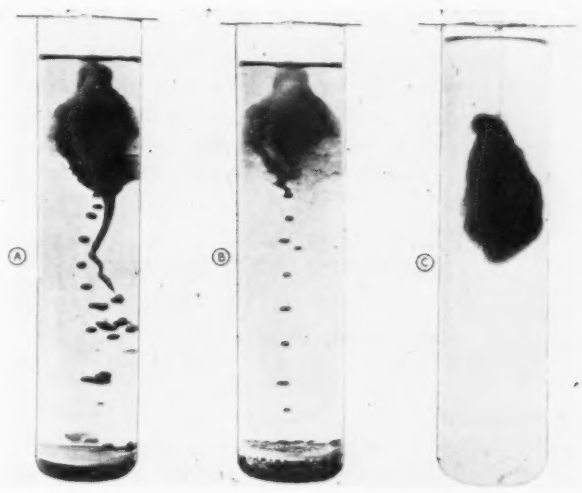


Fig. 1. Demonstrating the action of water displacing fluid. In these photographs water-saturated cotton wool has been suspended in:

(A) Dewatering fluid—early stage after 10 seconds showing discrete drops and a continuous stream.

(B) Dewatering fluid after 1 minute when the last isolated drops are falling. The displaced water has settled to the bottom.

(C) A conventional lanolin/white spirit temporary protective (DTD 121D)—after 1 minute but the same result persists indefinitely. No water is displaced.

Note: The water has been dyed to assist photographic presentation.

(Courtesy Scientific Lubrication, January, 1949)

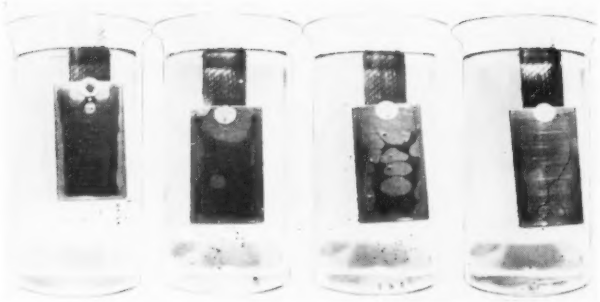


Fig. 2. Photographs showing various stages in the water-displacing action when a wet metal plate is dipped into a water-displacing fluid. These particular stages were separated by a time interval which was only a matter of seconds.
(Courtesy Scientific Lubrication, January, 1949)

125° F. Some of the dry coating can be painted on, but most of them cannot. When necessary the film can be removed in a trichlorethylene degreaser by swabbing with paraffin or in an ordinary alkaline cleaner.

However, there are on the market non-residual types of de-watering fluids which possess powerful de-watering properties but after evaporation leave no appreciable residue. This is particularly suitable for the drying of plated surfaces with the avoidance of water stains. It might be thought that the function of a non-residual type of dewatering fluid could be filled by a volatile water-miscible solvent such as methylated spirits, etc., but such liquids suffer from the disadvantage that, since they retain water, they reach a point where they become ineffective owing to the film of water they leave after the solvent has evaporated. The de-watering fluid, too, has a higher flash point than most easily available water-miscible solvents, which is a big advantage.

Applications in the Metal Finishing Industry

Some applications in metal finishing will be immediately obvious. It has been proved that water staining of plated work can be avoided by rinsing in water followed by dipping in water-displacing fluid for two or three minutes. Drying is still necessary

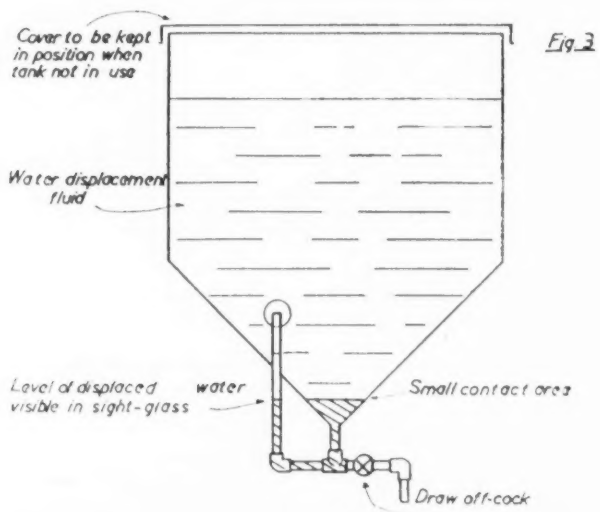


Fig 3
Cover to be kept in position when tank not in use
Water displacement fluid
Level of displaced water visible in sight-glass
Small contact area
Draw off-cock

Fig. 3. Useful tank arrangement for handling water-displacing fluid.

although the liquid to be evaporated in this case is petroleum solvent instead of water, and the surface is left covered with a thin coating which protects the finish from finger marking, tarnishing and corrosion during transport, storage and assembly, and which can be easily removed when it has served its purpose. If the protective coating is not required, the articles can be dried quickly by transferring them from the fluid to the trichlorethylene degreaser which will quickly remove the whole of the fluid leaving a clean, dry, unstained surface.

Chemical stains due to pickling, cleaning and other corrosive liquids oozing, some time after finishing, from lapped or badly rivetted or welded joints can

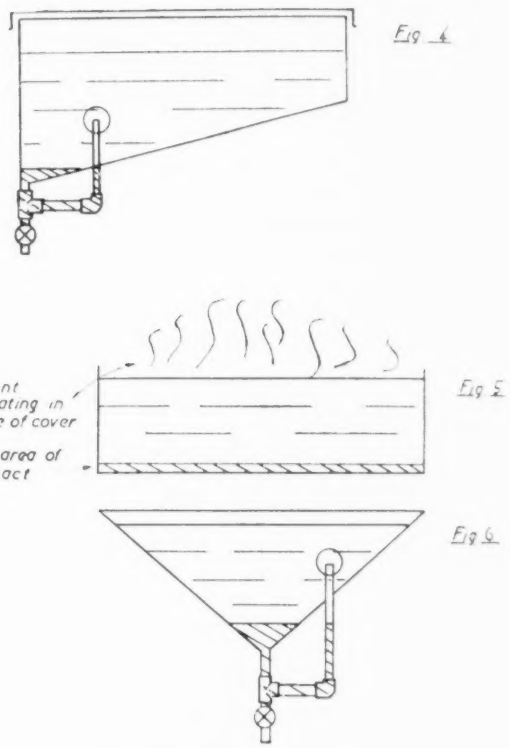


Fig. 4. Another tank arrangement suitable for handling water-displacing fluid.

Fig. 5. Incorrect method of handling water-displacing fluid. The area of fluid in contact with displaced water is here much greater than with a sloping bottom tank of equal volume.

Fig. 6. Tank suitable for use in conveyorized equipment.

be avoided in exactly the same way. The protection afforded by the film which remains is frequently of importance, since even if oozing of liquid does not occur the unplated crevices are among the earliest points to corrode, the rust first making the article unsightly and later spreading under the finish and lifting it off the metal surface. Water-displacing fluids are of very great penetrating power and may be expected to find their way into any crevices already containing aqueous liquid. However, water cannot be displaced unless there is an exit for it. Slow rotation of the part during dipping can be helpful here.

When dealing with tubular work it is almost impossible to rinse and dry the internal surfaces completely. In any case, condensation is likely to occur in cold damp weather and the result is internal corrosion which first makes its appearance at the joints.

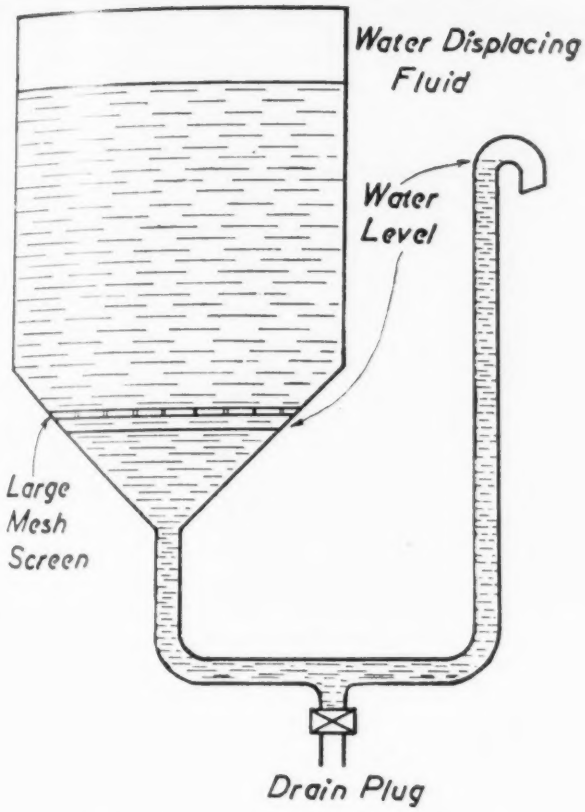


Fig. 7. Automatic syphon arrangement as recommended by the British Standards Institution.

Dipping the plated tubes into water-displacing fluid will remove all water and leave the internal surface covered with a protective film. This treatment is also recommended for tubes to be spray painted, even when they are not accorded any wet pre-treatment, because of the protective value of the coating on the internal surfaces. In this case a fluid should be chosen which leaves a film on drying which will accept paint.

The use of dewatering fluid is recommended for the protection of metal parts after cleaning and before painting so that the clean surface obtained is maintained prior to painting, thus permitting parts that have been cleaned to remain in storage for a period without any detriment before the final application of the finishing coating.

Unless a de-watering fluid of the paint-accepting type is used it is important to degrease before painting. In the case of the paint accepting type consideration must be given to avoid over-taxing the rust preventative properties by unduly long storage.

The process may also be applied with advantage to metal parts which have been pickled and water rinsed or phosphated and rinsed: elevated temperature drying of such parts can then be avoided. This factor is of considerable importance in as much that parts which have been pickled are invariably re-oxidized during the drying process and parts that have been phosphated tend to lose a certain amount of their protective properties after drying by heat through de-hydration of the coating. Moreover, by sealing the pores in the phosphated coating corrosion resistance is increased and the paint subsequently applied is conserved, since most phosphate coatings are highly absorptive.

Complaints are constantly being made that finished components not stored under the best conditions are tarnished when they are issued for assembly; that articles despatched abroad are found to show signs of rust on arrival; and that dull finishes—cadmium, zinc, nickel, etc.—are spoiled by water staining and finger marking long before they reach the customer. Use of a water-displacing fluid would appear to provide a practicable answer to all these problems. Incidentally, its growing use in the course of the manufacturing operations preceding finishing should help to provide the finisher with a better surface on which to work and thereby make its own contribution towards an improvement in the quality of finish obtainable.

Precautions to be Observed

As with all good things certain precautions need to be taken in using water-displacing fluids. Firstly, although not dangerously so, they are inflammable and naked flames must not be allowed in the vicinity. Secondly, their balance is easily upset by traces of acid or alkali and it is important to rinse thoroughly before immersion.

Finally, some of the essential constituents of the fluid are soluble in water and it is obvious, therefore, if one is to obtain maximum life from the fluid, that undue contact with the displaced water should be avoided. The usual method is to employ a mild steel tank with sloping bottom and draw-off cock fitted as close as possible to the lowest part of the tank, as shown in Figs. 3 and 4. When a wet metal surface is immersed in fluid contained in such a tank displaced water settles to the bottom and should be drawn off at frequent intervals. Comparison with Fig. 5 will show that the arrangement with sloping bottom greatly reduces the area of water and fluid in contact.

While volatility is not such a problem as it is with, say, warm trichlorethylene, fluid is conserved by fitting a lid to the tank and by shielding from strong air currents. In conveyorized plants, of course, lids cannot normally be used. Fig. 6 shows the usual type of tank for water displacing fluid in conveyorized equipment.

Fig. 7 shows an arrangement recommended by the B.S.I. Provided the correct head of fluid is maintained, excess displaced water is automatically syphoned off.

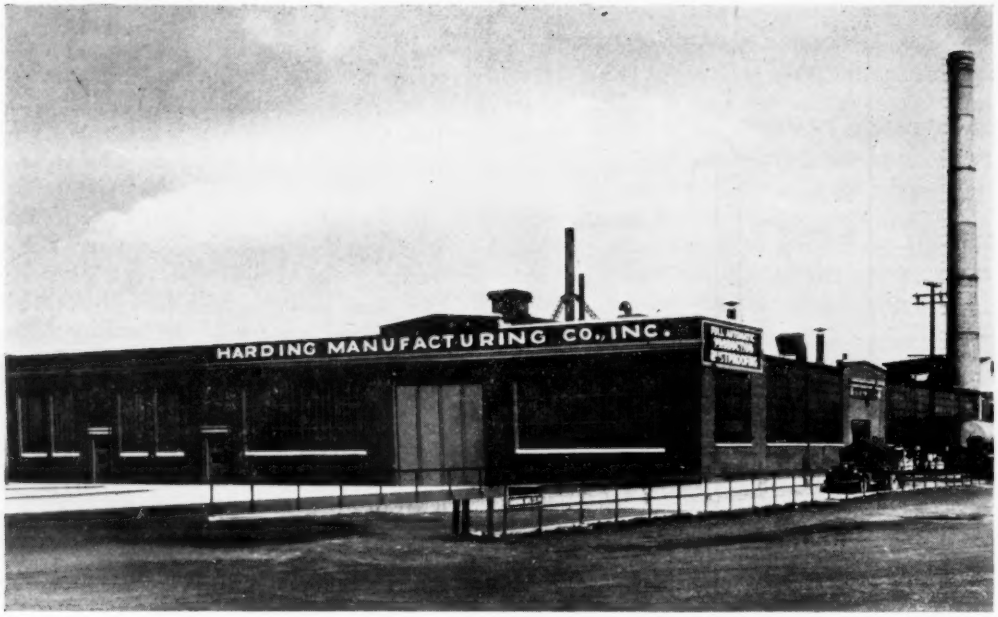
In conclusion, we would express our indebtedness to the following concerns for assistance in the preparation of this article:

Sunbeam Anti-Corrosives Ltd. for details of their Ferromede range of protective oils;

Shell Mex and B.P. Ltd. for details of the Ensis range of water-displacing protectives;

W. B. Dick & Co. Ltd. for particulars regarding their Ilo range of dewatering oils;

and the publishers of "Scientific Lubrication" for permission to reproduce Figs. 1 and 2, together with extracts, from an article by *D. L. Samuel* published in their January 1949 number.



A Plating Success Story

Harding Manufacturing Company

by

Edward Finne

IN 1943, *George Harding* founded the *Harding Manufacturing Co.* to engage in research work on new products and processes for industry. One of the first projects was the plating of aluminum. At one time during the war aluminum forgings were in great demand, and the primary purpose of this research work was the salvaging of forgings spoiled in machining, particularly by plating to size any oversized holes.

From a humble beginning and in the space of a few years, Harding has built his plant located at 10600 Gratiot Ave. into one of the largest job plating plants in Detroit. The present plant employs over 100 people, operates two buildings on 3½ acres of land and utilizes 22,500 square feet of factory space. His success is a result of his unceasing energy and work, backed up with the able assistance of *A. E. Betteley*, vice president and secretary; *Ray Eastin*, superintendent; *Michael Borushko*, technical advisor; *Robert McCarthy*, sales manager; and *Wesley Grougan*, production control.

One of the specialties at Harding is, naturally, their production plating on aluminum. For their process, Harding finally settled on the use of a proprietary process which features one pre-treatment cycle for all regularly-used alloys of aluminum. They are now nickel and chromium plating aluminum automotive parts and accessories, fishing rod parts, radio grilles and jewelry, plus other miscellaneous aluminum parts.

Their aluminum plating line is made up of still tanks, although the nickel tanks are equipped with cathode rod agitators. Their process is not necessarily restricted to tank operations of this type; automatic equipment can be used for plating on aluminum. However, the company feels that this set-up better fits their purpose, as it allows them to efficiently plate the wide variety of alloys encountered in job plating. Their process uses the same pre-treatment solutions for all alloys, but time requirements do vary with different aluminum alloys.

In addition to plating on aluminum, the company has built up a thriving business in the rustproofing field. Barrel plating of small parts is carried out in 14 zinc plating barrels and 6 cadmium barrels. Racked parts are plated in a 3000 gallon zinc semi-automatic unit, in still tanks, or in a full-automatic cadmium unit. Phosphating and copper plating are additional finishes available.

Zinc and Cadmium Plating

The zinc barrel line is one of the newer installations. All parts are tumble cleaned and pickled in one section of the line. Parts are then transferred to plating barrels and, at this point, all stock is weighed into the plating barrel according to standards set up by the Production Control Dept. This weighing insures proper loading of all barrels to meet the most efficient plating requirements, and also insures that cost requirements are met. The weighed plating barrel is then transferred to a 10-barrel plating unit.

The zinc barrel line has a battery of 12 rectifiers located overhead to provide the required current.

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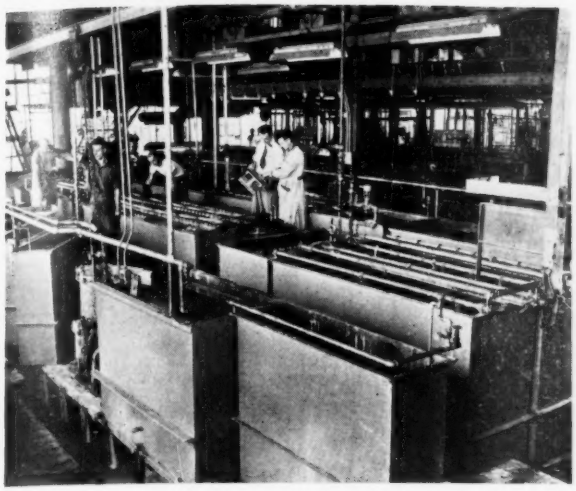

Figure 1. View of Harding's aluminum plating department.

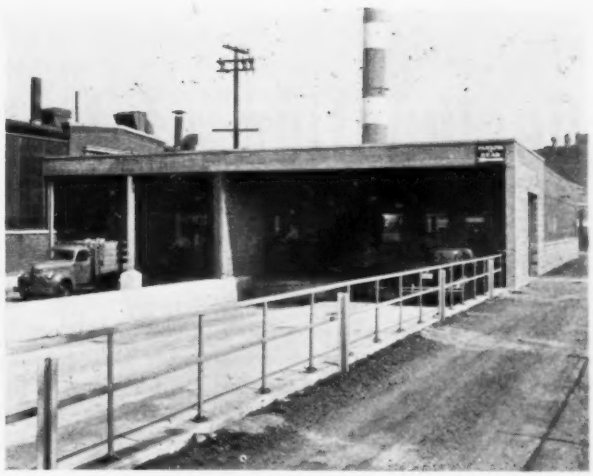

Figure 3. Rear delivery platform, illustrating efficient production system.

Amperage capacity is purposely kept about 20% higher than actually required and this is done to insure a constant minimum amperage in case of single rectifier failure.

Following zinc plating, parts may be either bright dipped and dried, or they may be given a dichromate treatment through the alternate drying system, which consists of a fully automatic dichromating machine.

Another 10 barrels located in other parts of the shop handle smaller lots of parts in cadmium and zinc. Springs or spring parts are sand tumbled to remove oxide films prior to plating. Following plating, all such parts are oven-baked to relieve hydrogen embrittlement.

Harding relies exclusively on rectifiers to provide current for all plating operations, and they employ 41 separate rectifiers generating 63,000 amperes for the shop. Their reliance on rectifiers is based on their theory that it is much simpler to remove and replace a rectifying unit in case of current failure than to repair a defective generator. Down time is thus kept to a minimum.

Production Control

The company is a firm believer in a uniform system of production control and has built up its method of cost estimation and work routing to a high degree of perfection.

Raw stock coming into the plant for finishing is received in their receiving department, which is equipped with 5 loading docks. Stock thus received is trucked immediately to raw stock areas in the plant which are located near the various finishing departments. Production Control then writes out a job ticket on which is listed part number, part name, customer's name, finish required, specifications to be met, and actually tells the departmental foreman how to run the stock. He is told, in the case of barrel plating, how much stock to put in a plating barrel and how long to run it. Racked material is treated in the same way; i.e., what rack to use, how many pieces to rack, how long to plate to meet specifications. All job tickets carry full information to the foreman as to finish requirements.

The basis for all standards has been worked out over a period of many years, and it is possible to find almost any plating information concerning parts in their vast file of production-proven standards. Estimates on new parts, if not available in their files, are worked out by the Production Control Department according to very definite standards and methods which are in

(*Concluded on page* 83)

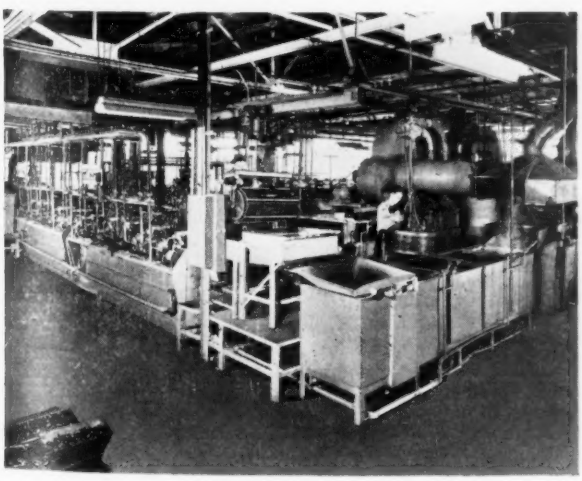

Figure 2. Zinc barrel line showing 10-barrel unit and two drying systems..

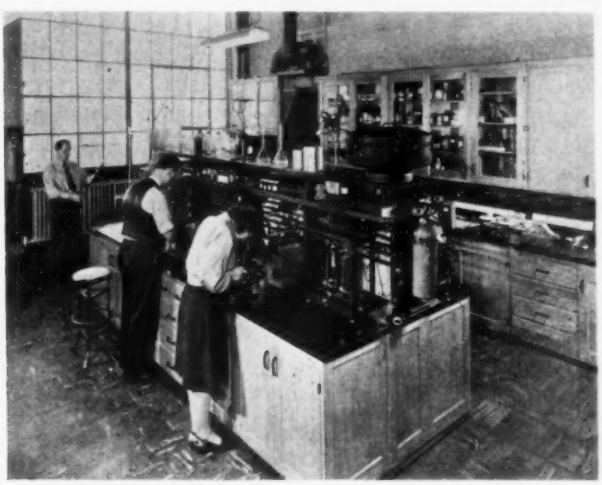

Figure 4. The well equipped laboratory where close control of solutions and deposits is exercised.

Designation of Metallic Surfaces - Part I

By Helmet Thielsch[1] and George Stroman[2]

With today's emphasis on brightness of deposits, levelling, electropolishing, etc., the methods used in measuring these surface characteristics should be more thoroughly understood. This article is the first in a series explaining the fundamentals behind the measurement of surface qualities.—*Ed.*

THE study and analysis of metallic surfaces represents a relatively new engineering field. The primary reason for this late development is that the early investigators were considerably handicapped by a serious lack of accurate measuring instruments. However, with the development of precision techniques came a greater desire on the part of various scientific and engineering groups to understand and describe accurately the properties and the topography of surfaces.

Various chemical, electrical and physical reactions of decisive significance occur at the surface of metals. The chemist, interested in problems of catalysis, began to realize that catalytic activity was influenced by conditions inherent to the surface. The corrosion engineer found that potential differences were affected by surface heterogenities. Electronic emissivity, as an electric reaction, was also influenced by surface conditions, and offered challenging problems to the electronic engineer.

Surface topography has become a primary consideration in problems of lubrication and wear. Here investigators found that a smooth surface was not always the most suitable. Thus a certain degree of surface irregularities are often specified. For example, if a machined finish fell below a given standard of roughness, poor wearing properties were often the result, due to glazing.[1] On the other hand, excessive irregularities also would have caused difficulties. Scratches and machining finishes, because of their action as stress raisers and their influence on fatigue strength, give additional concern to engineers.[2, 3, 4]

In electroplating, the quality of electroplated parts is found to be dependent upon the surface finish of the part prior to the plating process. Moreover, surface studies on electroplated materials are important, as they reveal how well a deposit fills the surface defects in the base metal and thus produces a smooth surface.

These are but a few examples which show how surface analysis aids in producing better materials and processes.

What Is a Surface?

By definition of the *American Standards Association*[5] and the *Society of Automotive Engineers*[6], the surface of an object is the boundary which separates that object from another substance.

However, in addition to the actual geometry or texture of the surface, the atomic characteristics or structure must also be considered. Thus a surface should actually be thought to consist of a thin metallic layer. For example, in a machined part this layer lies between the undisturbed base metal of the object and the atmosphere or substance on the other side. On metals, the outer part of this surface layer usually consists of oxides. A hypothetical surface is sketched in Figure 1.

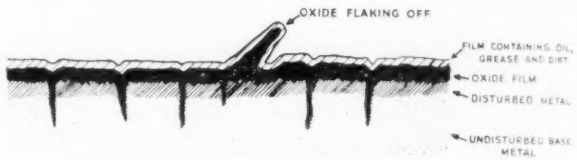

Figure 1. Hypothetical surface (After Perthen).

As *Portevin*[7] observed, the surface of a metal differs in nature, structure and properties from the metal itself. Thus the true metal itself is never observed, but only a mask which hides it.

It is generally accepted that the characteristics of a surface are a function not only of the geometry of the surface, but also of the structure of the material itself. This then leads to the consideration of three factors: (1) the geometry or shape, (2) the state of the surface layer, and (3) the behavior of the surface in the particular substance (usually the atmosphere). All three factors determine to varying degrees the chemical, electrical and mechanical properties of the surface.

It should be realized, however, that each mechanical surfacing operation, such as cutting, machining, polishing, buffing, etc., leaves its own individual markings. The same holds true for castings and surfaces treated chemically by pickling, electroplating, electropolishing, etc. Moreover, intermediate surfacing operations prior to the final finishing process may have more profound and permanent effects upon the properties of the surface than the final finish itself.

In any case, it is well known that the various surfacing treatments produce different types of surfaces. Their effects upon the metallic state of the surface layer and its behavior are important, and these significant factors shall be the subject of a subsequent discussion. For the present the *geometry* of the surface requires primary consideration. For this reason the present standards of surface roughness are concerned only with the geometrical topography.

Surface Terminology

In describing surfaces, we encounter the term of *nominal or mean surface*, which describes a hypothet-

1. *Welding Research Council, New York 18, N. Y.*
2. *Lukens Steel Company, Coatesville, Pa.*

ical, geometrically perfect two-dimensional boundary of separation. The nominal or mean surface is the surface which has no irregularities of any kind. This "perfect" surface would result if all the peaks were levelled off and used to fill in the valleys. In practice such a surface cannot be produced even with the best or finest finishing methods. The smoothest surfaces observed so far are on glass which had become solidified subsequent to melting in a flame.[8]

The differences between the mathematically ideal (*nominal or mean surface*) and the actual surface topography are the surface irregularities. Thus a practical approach to the measurement and control of these surface irregularities must be based upon their physical dimensions.

Studies of surface irregularities have led investigators to classify them into three major types: (1) roughness (2) waviness; and (3) flaws. A sketch of these is shown in Figure II.

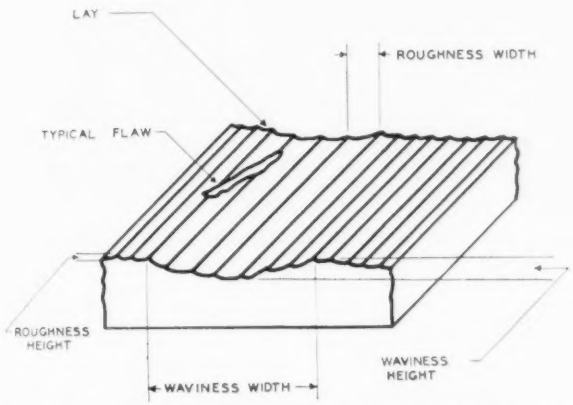

Figure II. Sketch illustrating major types of surface irregularities.

Surface Roughness

Surface Roughness consists of the relatively finely spaced surface irregularities that are typical of the surface.[5] The irregularities are inherent in any mechanical machining process. This surface roughness determines the appearance of the surface as well as its suitability for a particular purpose.

Roughness is a relative concept describing patterns of irregularities. The width of the roughness irregularities is usually 20 times or more as great as the height of these irregularities. Thus the width between these irregularities ordinarily varies between 0.0002 in. and 0.010 in., whereas the height is usually between 0.000001 in. and 0.0005 in.[9, 10, 11]

Waviness

Waviness describes those surface irregularities which have a width considerably wider than the roughness spacings. Relatively speaking, in waviness the width of the waves generally amounts to more than 100 times the waviness height. Thus the width varies usually between 0.04 in. and 1.0 in., while the height of the waves is generally less than 0.002 in. In fact, on most surfaces the height of waviness is found to be of the same order of magnitude as roughness height; that is between 0.000001 in. and 0.0005 in.[12] Because of the width of the waviness spacings, waviness is usually measured in inches or millimeters, whereas roughness is reported in microinches or microns. However, *waviness height* is also specified in microinches or microns, particularly because commercial manufacturers of surface measuring instruments seem to favor the microinch or micron designation for the heights of both roughness and waviness.

Waviness is generally the result of vibrations or deflection of the tool during operation, or it is caused by warping or strains in the specimen. The reflection of light will sometimes make waviness patterns readily recognizable to the eye. Moreover, roughness is generally superimposed on a wavy surface.

Flaws

Flaws are those irregularities which occur at one place or at relatively infrequent intervals in the surface. Scratches, cracks, dents and imperfections caused by the presence of slags, checks, blow-holes, scale, etc., represent typical examples. These irregular imperfections are extremely difficult to determine and measure, usually requiring special instruments and techniques.

Character of Surfaces

In addition to the three types of surface irregularities, their character or directional pattern is of importance. This is usually denoted by the term *lay* which, by definition,[5] is the direction of the predominant surface pattern. In most cases lay is characteristic of the final finishing operation. It may be subdivided into several classes:

1. *Transverse lay* is measured transversely to (across) the cutting or finishing action of the tool, whereas *longitudinal lay* is determined in the finishing direction. In cutting operations, longitudinal lay depends primarily upon the chip-forming characteristics of the material.

2. *Unidirectional or periodic lay* represents a uniform surface pattern of the irregularities. It is usually obtained in turning, milling, grinding and similar continuous machining operations.

3. *Multidirectional lay* denotes, as the name indicates, a multidirectional or highly irregular surface pattern. It is characteristic of lapping, polishing and superfinishing operations. Certain types of grinding operations may also be responsible for multidirectional lay. This, for example, is true on surfaces which have been finished with a Blanchard surface grinder.

Although two surfaces may exhibit the same degree of roughness, they may differ in their lay characteristics. This, for example, is true in honing and diamond boring operations. With the same degree of roughness, the different lay characteristics obtained in these two processes may vary the efficiency of the surface in particular applications; for example, the frictional behavior of these two surfaces might differ considerably.

Although lay represents an important characteristic of surfaces, it is not measured at all by the instruments which determine surface roughness.

Rating Surface Roughness

Various techniques are used to describe and rate surface roughness. Best known are the tracer instruments, which trace a highly magnified image of the surface. Examples of charts obtained with a *Brush Surface Analyzer* on several types of nickel plated specimens are shown in Figure III.[25] However, many

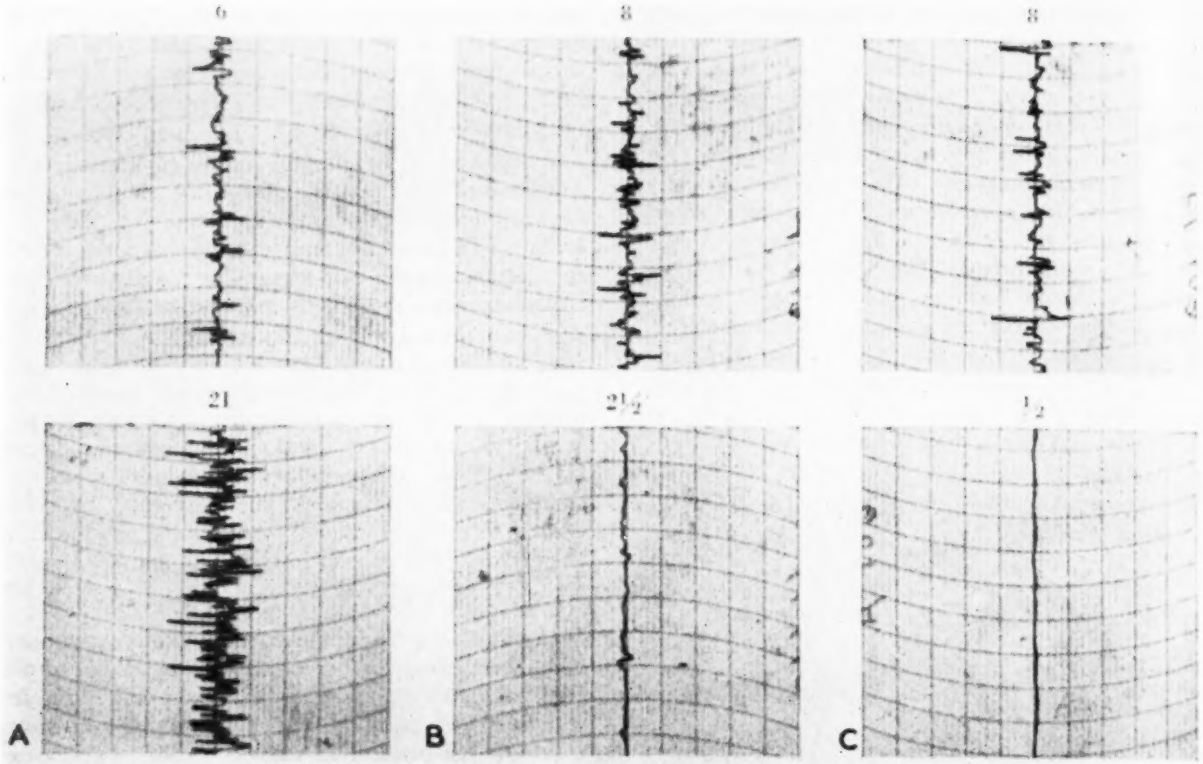

Figure III. Brush Surface Analyzer charts before and after nickel plating on grit-blasted surfaces (Grit No. 325). Top row across shows charts of panels before plating, bottom row across shows chart of same panels after plating with 0.002 inch Nickel in (A) Watts-type bath, (B) bright bath, and (C) semi-bright bath.[13] (Figures above charts represent root mean square readings.)

other types of instruments measure or indicate average heights of roughness and/or waviness.

Because most finishing operations are uni-directional, two surface sections are generally studied at right angles to each other. However, on surfaces with multi-directional lay, examination of one surface section may be sufficient.

The degree of surface roughness is generally described in terms of one of several values. The two most commonly used are: (1) the *root mean square average* (RMS or h_{rms}) or (2) the *arithmetic average* or *mean* (h_{ave}).

The *root mean square* average primarily owes its acceptance to the development of the *Abbott profilometer*. It is obtained by drawing an axis through the center of the irregularities (the nominal or mean surface), and dividing the axis into a number (n) of equally spaced intervals a, b, c, d, etc., as shown in Figure IV. At each interval the distance, or ordinates, are measured from the central axis to the curve representing the actual irregularities (the profile curve). From these values the root mean square average is calculated as follows:

$$h_{rms} = \sqrt{\frac{a^2 + b^2 + c^2 + \ldots}{n}}$$

Surface determinations made with most of the commercial tracer instruments do not require these mathematical calculations. The entire averaging process is *automatically performed in the electrical circuits*, and the running average is read directly on the meter as the tracer point is drawn across the surface.

The *arithmetic mean* is the average deviation of the profile curve above and below its mean surface. Thus,

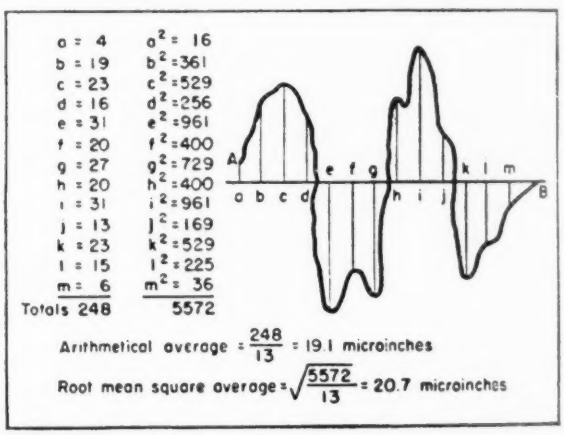
a = 4 a² = 16
b = 19 b² = 361
c = 23 c² = 529
d = 16 d² = 256
e = 31 e² = 961
f = 20 f² = 400
g = 27 g² = 729
h = 20 h² = 400
i = 31 i² = 961
j = 13 j² = 169
k = 23 k² = 529
l = 15 l² = 225
m = 6 m² = 36
Totals 248 5572
A
a b c d e f g h i j k l m
B
Arithmetical average = 248/13 = 19.1 microinches
Root mean square average = √(5572/13) = 20.7 microinches

Figure IV. Root Mean Square evaluation of surface roughness.

at each interval the ordinates measured from the axis to the profile curve are averaged.

In academic studies the arithmetic mean seems to be used almost everywhere in Europe, and is preferred over the root mean square evaluations in recent standards written in this country. Thus, the Society of Automotive Engineers recommended[6] the adoption of the arithmetic mean in their new 1949 standards on surface finish. The preference for the arithmetic mean is due to the elimination of squares and square roots which, unless evaluated by electric integration, are too tedious to measure from graphical determinations, plus the fact that the arithmetic mean is claimed to be more readily understood by shop personnel.

In industrial practice, however, the root mean square evaluations are almost exclusively used. This is primarily due to the fact that the major commercial tracer

instruments manufactured and used in this country, and also extensively exported to foreign countries, are calibrated in microinch or micron root mean square values.

Actually, the root mean square and arithmetic mean values are *so closely related* that differentiation is not too important in the usual commercial surface evaluations. Thus on most surfaces of ordinary roughness the arithmetic mean amounts to about 10% less than the root mean square evaluation. However, on extremely fine surfaces the differences may be somewhat larger. On the whole, such conversions represent loose approximations, and tracer instruments, which are calibrated to give root mean square readings, require special adjustment when arithmetic mean values are desired. This, however, is rarely practiced in industrial laboratories.

In a number of academic studies, neither the root mean square average, nor the arithmetic average may indicate the best relation of surface roughness to performance. For example, properties of wear and lubrication depend to a considerable extent upon the maximum deviation between the peaks and valleys and upon the contour of the surface.[14] In these cases one of several additional values is used at times to denote surface roughness. These are *maximum height* (h_{max}), *average height of profile* (h_1), and *average depth of hollows*.

The *maximum height* (h_{max}) is obtained by drawing two lines parallel to the nominal surface, one line touching the peaks and the other the bottoms of the valleys, as shown in Figure V. Unusually high or low irregularities are neglected, as they may have been created accidentally.

The *average height of the profiles* (h_1) is obtained by measuring the areas enclosed by the bottom line and the profile curve (Figure V), and then by dividing the obtained value by the length of the pen record.

The *average depth of the hollows* (h_2) represents the area between the top line and the profile curve divided by the length of the pen record and the magnification. It is apparent that $h_1 = h_{max} - h_2$.

Surfaces giving high and low values of h_1 are sketched in Figure VI. The parameter h_2 ($h_{max} - h_1$) provides a close relationship with the apparent smoothness of the surface, because as h_2 decreases the surface becomes smoother. (There is no relationship between smoothness and the maximum deviation h_{max}). Thus h_2 would represent the quantity of metal that would have to flow into the hollows to make the theoretical surface perfectly flat (smooth). Moreover, the smaller the fraction h_2/h_{max}, the greater the mating area between two surfaces which are in contact. Therefore, the distance h_1 (or h_2) presents one of the better values for problems pertaining to lubrication and wear.

Converting Roughness Values

Because the relationship between the various surface roughness values is affected by the actual geometry of the roughness, the use of definite factors allowing conversion from one value to another is not applicable. Moreover, no one of the values takes into account *all* the roughness characteristics which may be of particular interest. Thus their primary value to academic studies is that they give satisfactory *comparisons* between surfaces of similar materials which are produced by similar finishing methods. This, of course, is the main function of the values, because most specifications require finishing of a surface to a certain roughness range, which is compared to standards established by and based upon practical experience.

Some general correlation, however, may be made. The differences between the arithmetic and the root mean square averages were mentioned already. However, when it is desirable to determine the maximum deviation (h_{max}) from tracer instrument readings (h_{rms}) of machined or otherwise rough surfaces, a conversion factor of 3 to 5 times the profilometer readings would approximate the maximum roughness deviation.[15, 16] For Hyprolapped, sandpapered, and superfinished surfaces a factor varying between 7 and 10 would be more appropriate.[15, 16] If values for h_{max} were obtained from the charts made by tracer instruments, then the h_{max} read from these charts would amount to about 60-75% of the actual, maximum deviation. Such differences were determined by direct measurements using taper sectioning techniques.[17]

Rating Surface Waviness

In addition to roughness, the waviness of most surfaces must be analyzed. This is particularly important in applications where the wearing characteristics (friction, seizure, etc.) of two surfaces in contact are of

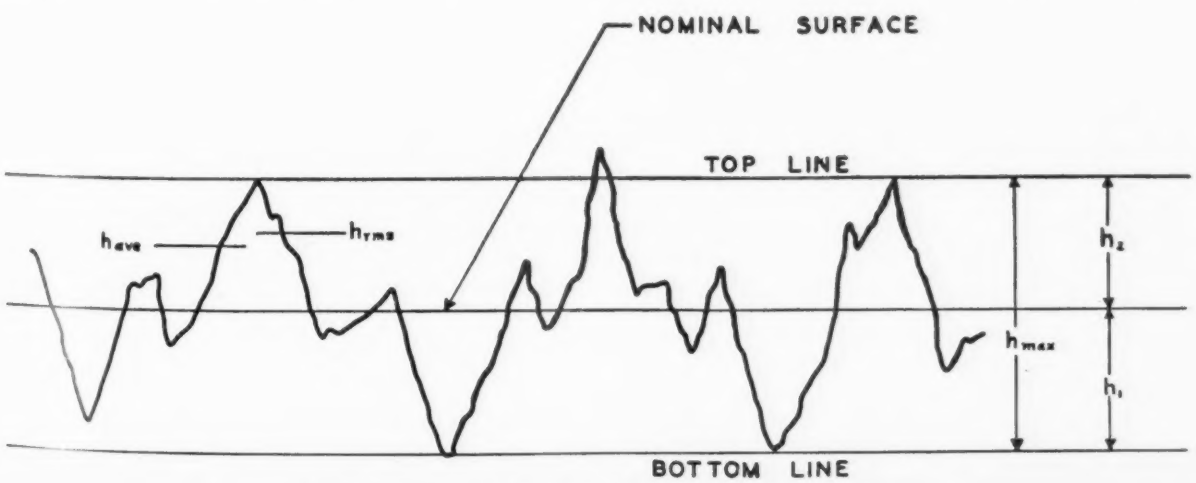

Figure V. Measurement of maximum height of surface irregularities.

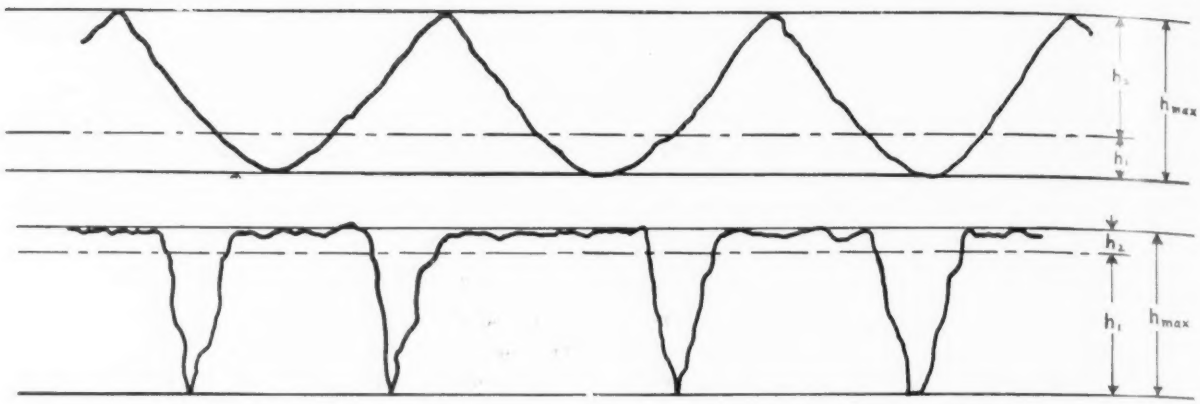

Figure VI. Comparison of two surfaces having same h_{max} values, but widely different h_2 values.

primary interest. For example, the load-carrying capacity of journal bearings is primarily controlled by surface waviness.[18] Thus, in addition to a particular roughness, surface waviness is also often specified.

Because waviness is concerned with the macrogeometry of the surface, it is more readily and accurately measured than surface roughness. Moreover, differences between waviness values obtained by various measuring instruments are relatively smaller. Thus, whereas in ordinary shop practice waviness is generally determined by means of a dial indicator, accurate, recorded determinations are usually made with tracer instruments.[19]

Waviness width and waviness depth are the only values used to describe these irregularities. Whereas waviness width is usually reported in inches or millimeters, waviness height is evalued either in inches or millimeters, or, more commonly, in microinches or microns.

Table I

Conversion of Units Used in the Dimensional Analysis of Surfaces

inch		microinch	millimeter (mm)		microns (μ)
1			25.4		
0.1	10^{-1}		2.54	2.54	
0.01	10^{-2}	10,000	0.254	2.54×10^{-1}	254
0.001	10^{-3}	1,000	0.0254	2.54×10^{-2}	25.4
	10^{-4}	100	0.00254	2.54×10^{-3}	2.54
	10^{-5}	10		2.54×10^{-4}	0.254
	10^{-6}	1		2.54×10^{-5}	0.0254
	10^{-7}	0.1		2.54×10^{-6}	0.00254
	10^{-8}	0.01		2.54×10^{-7}	0.000254

10^{-7} mm = 1Å (Angström Unit)

Summary

Although in a broad sense surface quality is a condition and not a dimension, many factors determining quality can be closely related to surface roughness or waviness, as described by one or several values. For example, such factors as wear, friction, abrasion, lubrication, corrosion, fatigue strength, notch sensitivity and others are closely related to, or they at least influence the life of the surface. The optical properties, such as reflection of light (brightness), and the adhesion of electroplated coatings, paints, etc., are also affected by surface roughness. Therefore, the understanding and the designation of surface finishes by certain indexes represents an invaluable aid to engineering and production personnel.

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Complex Compounds in Industrial Electroplating-Part II

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Complexes in Chromium Plating

The mechanism of the electrodeposition of chromium has been one of the most baffling problems in the science of electroplating. There is only one chromium plating solution used industrially. That is the chromic acid solution containing an acid radical such as $SO_4^=$ in such concentration that the CrO_3 : $SO_4^=$ ratio is close to 100.[47] The $SiF_6^=$ radical has been used[48] in place of some or all of the $SO_4^=$. There has recently been introduced a solution for the electrowinning of Cr from its ores, which is essentially a solution of $Cr_2(SO_4)_3$ and $CrSO_4$[49] but this has found no application as a plating medium, since the deposits thus far obtained are dark, coarse, and rough, and certain operating difficulties are encountered.

The major source of chromium in the CrO_3 solution is the complex dichromate anion, and the major reactions at the cathode are hydrogen evolution, reduction to trivalent chromium, and deposition of chromium metal. The latter proceeds with a current efficiency of 15-20% under the best industrial operating conditions. Because of the low efficiency and poor throwing power of the chromium plating solution there has been intensive research toward its improvement and toward the development of other systems, but no significant progress has been made in either direction.* The complex compounds of trivalent chromium have been intensively studied for almost fifty years, but none of these has produced a satisfactory plating solution.[50] In fact, most of them do not electrodeposit an appreciable amount of reasonably pure coherent chromium metal, with the exception of the electrowinning bath previously mentioned, and in it the divalent chromium ion seems to be the active material.

Returning then to the CrO_3 solution, the statement that the complex dichromate ion is the major source of Cr and that the reduction proceeds with low efficiency is about as far as one can go with general agreement. Since the earliest research on chromium plating, the question of direct reduction of the dichromate ion to chromium vs. the stepwise reduction via Cr^{3+}, Cr^{2+}, etc. has been argued. What experimental evidence exists seems to favor the direct reduction,[41] although until very recently the evidence was somewhat weak. The more widely held opinion hypothesizes an intermediate formation of Cr^{3+} which was then reduced through a few other stages to metal. Complicated mechanisms have been proposed that involve chemical reaction between Cr^{2+} and $Cr_2O_7^{2-}$ to produce Cr^{3+}, followed by electrochemical reduction of the Cr^{3+} to Cr^{2+}, some of the latter reacting with the $Cr_2O_7^{2-}$ and the rest of it being electrochemically reduced to Cr metal. The experimental evidence is certainly no stronger than that for direct reduction. In a recent paper,[42] it has been shown by radioactive tracer methods that in solutions containing both $Cr_2O_7^{2-}$ and Cr^{3+}, all of the chromium that is in the cathode deposit comes from the $Cr_2O_7^{2-}$. It further showed that the Cr^{3+} in the solution is completely inert with respect to the cathode reaction, though at the cathode there is produced trivalent chromium which remains in the solution. It is clear then that the trivalent chromium complexes identified by *Kasper*,[43] or other complexes, are too stable to be broken down at the cathode. In the light of this information, if the process is still to be considered as a stepwise reduction, the average life of the trivalent chromium formed as an intermediate product must be appreciably shorter than that permitted by the rate of complex formation of the Cr^{3+} with its environment. That is, if in the reduction of the $Cr_2O_7^{2-}$ to Cr^0, one must pass through a Cr^{3+} stage, then the rate of the process

$$Cr^{3+} + n(e) \rightarrow Cr^{(3-n)+}$$

must be appreciably greater than the rate of

$$Cr^{3+} + 6H_2O \rightarrow [Cr(H_2O)_6]^{3+}$$

(This equation is used only as an example rather than as an indication of a specific complex-forming reaction.) There are no data available on the rates of the complex-forming reactions in this system, but since they are believed to be quite rapid, the life of the Cr^{3+} in any stepwise mechanism may be so short that one may reasonably consider it as passing instantaneously through this stage. In other words, the reduction is direct and not stepwise. This work adds additional evidence to the belief that the

$$Cr_2O_7^{2-} \rightarrow Cr^0$$

and

$$Cr_2O_7^{2-} \rightarrow Cr^{3+}$$

are simultaneous reactions rather than part of the same process. It should be noted, on the other hand, that this question cannot be resolved until further information is available on the state and composition of the complex chromium compounds in the solution, and their rates of formation. If it should turn out that the rates are such that a stepwise reduction is not impossible,

Editor's Note—A recently announced commercial chrome plating bath claims significant improvement in both throwing power and overall bath efficiency.

then the complex-forming reactions might, as competing reactions to that of reduction to metal, turn out to be one of the major causes of the low efficiency of chromium plating. Further information is also needed on the divalent state of chromium and its complexes.

The question of the function of the SO_4^{2-} or other acid radicals in the system is still very much in doubt. It is known that in the absence of the small amount of SO_4^{2-}, or in the presence of too much or too little, no Cr is obtained at the cathode. All that is certain is that the sulfate must be present in some sort of chromium complex and that its action in any theory must be consistent with this fact. The early cathode diaphragm theory has most recently been expounded with new implications by *Snavely*.[44]

One other point of interest with regard to complex compounds in chromium plating is the use of the $[SiF_6]^{2-}$ complex anion in place of some or all of the SO_4^{2-}. It has been found that in the presence of this ion, interruptions of the current do not interfere with further chromium deposition to the extent that they do in straight sulfate baths. For this reason bulk and barrel chromium plating are usually done in solutions containing $[SiF_6]^{2-}$ (Ref. 45).

Complexes in Zinc Plating

Zinc is electroplated almost entirely from two general types of solutions: the acid zinc bath and the cyanide zinc solution. The former is an acid solution of $ZnSO_4$, and is used mainly in strip and wire plating. Since it is a simple ion solution it is of no further concern here. The cyanide zinc solution is made up with zinc cyanide, sodium cyanide, and sodium hydroxide. Because of its high alkalinity, the solution is essentially a "mixed complex" bath containing both $[Zn(CN)_4]^{2-}$ (Ref. 46) and the $[Zn(OH)_4]^{2-}$ (a hydrated form of $(ZnO_2)^{2-}$) ions. Conductivity and pH measurements show that 75 to 90% of the zinc is in the zincate rather than in the cyanide complex.[47] This raises an interesting problem when we further note that the concentration of NaOH may be varied over a fairly wide range without serious effects on the deposit, while the cyanide content of the solution is quite critical, especially in bright plating. In addition, deposits produced from zincate solutions are dark and coarse-grained and in general are very different in appearance from those from cyanide solutions. Here we have a clear example of a complex ion that is a minor constituent of the solution having a far more important effect on the deposit than has the ion present in greatest concentration. This illustrates a general principle, i.e. that the most available metal-containing ion in the solution is not necessarily reduced at the cathode, but that some intermediate ion, obtained either by partial reduction or by dissociation, may be the immediate source of metal at the cathode. This point will be expanded when mechanisms of deposition from cyanide solutions are discussed in connection with silver plating.

A number of bright zinc plating solutions have attained wide use. In one type[48] an aryl hydroxy aldehyde or ether aldehyde, e.g. vanillin or piperonal, is used as a brightener, frequently together with a trace of Mo or other metal with high complex-forming tendency. The nature of the action of these materials is not understood, but there is no doubt that highly stable chelate compounds are formed with metals by the orthohydroxy aldehydes, and that other types of complexes are formed by those aldehydes whose oxy group is too far removed for chelate formation. In the presence of these brighteners the solution becomes very sensitive to metallic impurities, and provision must be made for its purification. The use of a soluble sulfide in zinc solutions[49] has been recommended as a brightener, but its function is clearly that of removing impurities such as lead and cadmium, but not copper. As little as 0.1 g/l of copper may make zinc deposits unacceptable.[50] Zinc dust has been used to remove the copper, but with serious interruption of production and other difficulties. Preliminary experiments have shown some promise for the use of organic sulfur-containing compounds of the types used as rubber accelerators to meet this problem, since some of these materials form highly insoluble and stable complexes with copper.

Another type of bright zinc bath which is less sensitive to impurities has been used. This solution, however, gives only semi-bright plates and requires a final bright-dipping operation after the plating. The brighteners used in this system, polyvinyl alcohols,[51] are also capable of forming a variety of stable complex compounds.

Complexes in Cadmium Plating

Electroplating with cadmium is done almost exclusively from cyanide solutions. They are prepared by dissolving CdO in NaCN, so that the NaOH content of the solution is equivalent to the cadmium content. The major metal-containing complex is the $[Cd(CN)_4]^{2-}$ ion[52] though there is evidence for the existence of $[Cd(CN)_3]^-$ and possibly the cation $[Cd_2(CN)_2]^{2+}$.[46] Since cadmium is not an amphoteric metal, there is no appreciable alkaline complex ion formed, and the alkali in the bath serves chiefly to reduce the hydrolysis of NaCN. The ion $[Cd(CN)_4]^{2-}$ is of intermediate stability. Sulfide will precipitate CdS from solution, and silver will displace the cadmium from the complex. Free cyanide is determined analytically[53] by titrating with $AgNO_3$ using KI as indicator. The end-point of this reaction occurs at an Ag^+ concentration of approximately 10^{-14} M/l. and at a $(CN)^-$ concentration of approximately $10^{-4}M$/l. The value for the instability constant of $[Cd(CN)_4]^{2-}$ is difficult to determine, but it has been established[9] as 10^{-18} to 10^{-20}. The lower of these values gives a concentration of $(CN)^-$ of 10^{-4} M/l in molar $[Cd(CN)_4]^{2-}$ solution, indicating thereby that the value obtained by this titration may have some real meaning. If one titrates, as before, with $AgNO_3$, but instead uses $K_2Cr_2O_7$ as indicator, one obtains the total cyanide content of the solution. The end point of the reaction using the chromate indicator occurs at a $(CN)^-$ concentration of 10^{-6} M/l. and a Ag^+ concentration of 10^{-10} M/l. ($K_{s.p.}Ag_2CrO_4 = 1.7 \times 10^{-12}$). The higher Ag^+ concentration at this end-point is sufficient for the reaction $[Cd(CN)_4]^{2-} + 2\ Ag^+ \rightarrow 2\ [Ag(CN)_2]^- + Cd^{2+}$ to go to completion. A similar titration cannot be run with the cyanide copper solution because the complexes present at the end-point obtained with KI are more stable than the $[Ag(CN)_2]^-$,

hence the first excess of Ag^+ after the KI end-point will also give an end-point with chromate. To obtain total cyanide in the copper solutions one must decompose the complex with acid, distill the HCN into NaOH and titrate the excess NaOH.

The brighteners which have been used for cadmium plating are so varied and so numerous that they defy classification. From the first brightener used, a caustic solution of wool,[54] the brighteners for cadmium have provided more amusing stories of empiricism in industrial developments than they have information of scientific value.

Tin Plating Complexes

A very large number of solutions have been proposed and used at various times for electrodepositing tin, but only a few survive today. The electrodeposition of tin presents a number of problems that arise from two characteristic properties of tin salts, their tendency to undergo hydrolysis with the formation of difficultly soluble salts, and the ease of oxidation-reduction reactions to occur in either divalent or quadrivalent tin solutions, making it difficult to keep the tin in solution in either one or the other state. The development of tin plating has been somewhat different from other systems in that the earliest solutions involved complex materials, but these are being replaced to a large extent by simpler formulations. The problem of hydrolysis was first attacked and this was done by means of a wide variety of complexing agents. In one of the first commercial tin solutions (ca. 1850) the tin was present as a complex stannous pyrophosphate anion in strongly alkaline solution.[55] This solution caused difficulty because of oxidation of the Sn^{2+} to Sn^{4+} with the development of spongy deposits. Other complexing agents such as tartrates and cyanides were tried, but gradually the alkaline divalent tin baths dropped out of use. Acid stannous baths of simple composition were then developed, in which $SnSO_4$ was dissolved in H_2SO_4, and reducing agents and addition agents were added. Without the latter this solution produces isolated needles or spongy deposits. With further development of addition agents, the acid sulfate bath has been made practicable and is in wide use today. Some solutions have as many as three addition agents, for example, cresol sulfonic acid, beta-naphthol, and gelatin.[56] For a short time a stannous fluosilicate[57] solution was used, but with the development of suitable addition agents, this gave way to the sulfate solution.[58] Recently, the fluoborate system has come into use for tin plating and is said to have highly desirable properties.[59]

Where higher throwing power is desired than is obtainable with acid solutions, the sodium or potassium stannate baths are used.[60, 61] In these, the tin is present as the hydrated stannate ion, possibly $[Sn(OH)_6]^{2-}$, and sodium acetate is added as a buffer. The widespread use of the bath became possible when the serious harmful effects of stannite in the solution were realized and counteracted. Even small amounts of divalent tin cause the formation of spongy deposits. The use of sodium peroxide to keep the tin oxidized, and the careful control of anode current density so that the anodes dissolve to form stannate and not stannite, were the important contributions to this end. It is also claimed that the acetate assists in anode corrosion. The stannate solution has certain disadvantages, the most important of which is a slow deposition rate that results from low efficiency (about 60-90%) and a low electrochemical equivalent of tetravalent tin. One of the important properties of complex ions is the stabilization of a particular valence state of polyvalent metals. Such examples as the monovalent copper and gold in cyanide solutions, and trivalent cobaltammines are well known. A complex system in which either of the valence states of tin would be stable, to the practical exclusion of the other, would be of great value in tin plating, provided, of course, that the system had other properties required of plating solutions. Such a system has thus far not been found.

Lead Plating Complexes

Because of the insolubility of the common lead salts, this metal is plated almost exclusively from complex anion salts in which the lead is present as a simple cation. The two systems from which lead is commonly plated are the fluosilicate and the fluoborate. The former is used for electrorefining while the main application of the latter is in electroplating.[62] This difference arises from the fact that the fluoborate gives finer-grained, denser deposits and the solution is less subject to decomposition, but the fluosilicate is cheaper. In addition, for deposition on steel or iron, a preliminary Cu strike is required before plating from the fluosilicate bath, while the fluoborate may be used directly on these metals. The fluoborate solution is prepared from $Pb(BF_4)_2$, HBF_4, and an excess of H_3BO_3, contained in a commercially available concentrate, or it may be prepared (with more difficulty) from HF, H_3BO_3, and $Pb_3(OH)_2(CO_3)_2$ (basic lead carbonate). The major anion present is $(BF_4)^-$, but the presence of additional unknown complexes is indicated by anomalies in conductivity and heat of solution.[82] In all fluoborate solutions it is necessary to have free fluoboric acid to prevent the hydrolysis of the salt, and free boric acid to prevent the hydrolysis of the complex anion. The BF_4^- ion has none of the properties of its components. HBF_4 is an acid comparable in strength to H_2SO_4, while HF and H_3BO_3 are very weak acids in water solution. The HBF_4 does not attack glass and may be shipped in glass, provided an appreciable excess of H_3BO_3 is present. In the absence of the excess H_3BO_3, the reaction $[BF_4]^- + 3H_2O \rightleftharpoons H_3BO_3 + 3HF + F^-$ proceeds to liberate hydrofluoric acid and fluoride ion. The concentrate of $Pb(BF_4)_2$ as shipped has 4% of free H_3BO_3 (by weight) and no appreciable hydrolysis is observed. On account of this hydrolysis, serious difficulties have been encountered in analysis of fluoborate solutions by titration with alkali because the hydrolysis rate increases as one approaches the end-point.[62] In practice, empirical methods of titration are reasonably satisfactory, because the solution composition is not very critical, so long as some free HBF_4 and H_3BO_3 are present.

A method[79, 80, 81] has been developed for fairly accurate analysis of fluoborate solutions, which involves: (1) removing the metal as sulfide, (2) hydrolizing the $(BF_4)^-$ with $CaCl_2$ to produce CaF_2, H_3BO_3 and HCl, (3) titrating with NaOH to the methyl orange end-point to determine the HCl liberated, and continuing the titration to the phenolphthalein end-point (in the pres-

ence of mannitol) to determine the H_3BO_3. The HCl liberated is proportional to the total $(BF_4)^-$, and the H_3BO_3 contains all the boron present in the $(BF_4)^-$ and free H_3BO_3 in the sample. The metal is first removed because, if present, its precipitation as the hydroxide would interfere with the titration. If the total metal content is determined, the combined $(BF_4)^-$ may be calculated and thus the free HBF_4 determined by difference. The B in the total $(BF_4)^-$ may be calculated and the free H_3BO_3 determined by difference.

The hydrolysis with $CaCl_2$ is not fast or complete, and it is necessary to alternately titrate and reflux until no appreciable change in end-point occurs. There is still some uncertainty as to whether the end-point corresponds to a true stoichiometric value. Other methods to overcome this difficulty are sometimes used. These involve the precipitation of KBF_4 in alcoholic solution to determine total $(BF_4)^-$, and the hydrolysis of the solution with $CaCl_2$, distillation of methyl borate to remove it from the solution and conversion of the methyl borate to H_3BO_3 and its titration to determine total boron. These latter methods are also used when the metal cannot be easily removed in acid solution.

The fluosilicate bath has as its anion $[SiF_6]^{2-}$. As in the fluoborate solution, free $H_2[SiF_6]$ must be maintained to prevent hydrolysis of the $Pb[SiF_6]$, but hydrolysis of the anion cannot be prevented because no appreciable amount of H_2SiO_3 can be maintained in the solution, and its corrosiveness makes free HF undesirable in the solution. Therefore the $[SiF_6]^{2-}$ undergoes hydrolysis and accounts for the greater sludge formation in this system as compared to the fluoborate. The sludge is composed largely of PbF_2 and SiO_2.

Both solutions require the use of comparatively large amounts of glue as an addition agent to prevent treeing of deposits.

Complexes in Indium Deposition

Indium plating has in recent years attained a fairly large volume of production in bearing manufacture. The indium coating greatly increases the corrosion resistance of the bearings.[63] Most indium plating is done from cyanide solutions.[64] An early cyanide solution containing only $InCl_3$ and NaCN gave trouble due to the hydrolytic precipitation of $In(OH)_3$. The addition of glucose (dextrose) or glycine was found to reduce, but not eliminate this precipitation.[65]

A solution containing $InCl_3$, KCN, and dextrose with a higher In concentration, and a much higher pH, obtained by adding 30-40 g/l KOH, is said to be stable.[66]

The metal-containing complex ion is considered to be $[In(CN)_4]^-$. It has been noted that indium is the only trivalent metal which can be plated from a cyanide solution.[6] Although indium is only slightly amphoteric, the fact that a higher pH reduces hydrolytic precipitation indicates that some $[In(OH)_4]^-$ might also be present. The effect of the organic agents mentioned above on the stability of the solution is most likely due to the formation of complexes with the indium which renders it more stable to hydrolysis. It should be noted that in this solution the dextrose is not used in trace amounts, as is usual with addition agents, but rather, in amounts equal to the indium present. This solution can therefore be classified as a "mixed complex" bath.

A solution which has been used in England consists of $InCl_3$, ammonium tartrate[67] and ammonia. It is an alkaline bath, evidently based on a complex tartrate of indium.

In addition to the cyanide solution, acid solutions such as indium fluoborate[59] and simple $In_2(SO_4)_3$[68] have been used.

Silver Plating Complexes

The first patent for the electrodeposition of silver (and one of the first patents issued in electroplating) was granted to *Elkington* in 1840 for the deposition of silver from a cyanide solution. Attesting either to the genius of this early worker, or to a lack of significant progress in this field, modern industrial silver plating solutions are not significantly different from that described therein. Silver plating solutions are prepared by dissolving AgCN in NaCN or KCN (more frequently the latter) and adding a carbonate and brightener. The composition of complexes in silver-cyanide solutions is believed to be fairly simple. Since Ag^+ exhibits a coordination number of two and since AgCN is an insoluble molecule, $[Ag(CN)_2]^-$ is about the only possible formula for a complex anion involving Ag and CN, and various measurements have shown this to be the ion present.[73] In some early work, evidence of the existence of $[Ag(CN)_3]^{2-}$ was claimed, but this has not been confirmed by later workers.[6] Because of the apparent simplicity of this system, a fair amount of work has been done on the mechanism of deposition from complex cyanides, using Ag solutions. The most evident difference between silver deposits from cyanide solution and those from a simple solution, e.g. nitrate, is that the former are smooth, coherent, and fine-grained, and the latter are coarsely crystalline and, in most cases, form a mass of individual silver needles. In attempting to explain this difference, many workers start with the hypothesis that, in plating from complex systems, the deposition of metal does not occur by cathodic reduction of a metal ion; but rather that the deposition occurs as a secondary, non-electrochemical step. As a result, there is no opportunity for large crystals to form, the metal being deposited in a random manner to give smooth fine-grain deposits. As an alternative, it has been suggested that the metals are deposited by reduction of metal ions that originate from the dissociation of the complex ion, but that the concentration of metal ions is too small to permit normal crystal growth.[2] *Haber*[3] and *Glasstone*[69] have pointed out, however, that the calculated metal ion concentration in the Ag-cyanide (and even more so in Cu-cyanide) solutions is so small, that a reasonable rate of deposition would involve ridiculously high rates of reaction and impossible high electron velocities. To describe a series of primary and intermediate steps, there have been as many theories as there are possible intermediates; and, as has been seen in recent developments in the kinetics of chain reactions, possible intermediates are as abundant as chemical journals; proving their existence, however, is another matter. An early theory of Ag plating attributed to *Hittorf* postulated the electrochemical reduction of K^+ to K followed by the chemical reduction of $[Ag(CN)_2]^-$ by K to give Ag, K^+ + $(CN)^-$. *Glasstone* points out that the normal reduction

potential of K is about —3 volts and that silver plating occurs at a cathode potential of about —0.3 volt. Hence the reduction of K^+, even as an alloy in which its free energy is appreciably reduced, is unlikely. Glasstone has put forth the theory that complex cations such as $(Ag_2CN)^+$ may exist in the solution and be reduced at the cathode. The process would then be $(Ag_2CN)^+ + e \rightarrow (Ag_2CN)^0 \rightarrow Ag + Ag^+ + (CN)^-$. Glasstone calculates that if the indicated complex cation were present only to the extent of 10^{-4} moles/l. it could account for the silver deposition. He has extended this theory of the reduction of intermediate cations, followed by chemical decomposition of the resulting neutral radical, to copper, zinc, and other systems. A recent study of zinc plating by *Glazunov* also produced a theory of this type for zinc plating.[70] In his series of papers, Glasstone discounts without further consideration the early suggestion of *Haber*[3] that the complex anion present in the solution is discharged and then chemically decomposes.

However, there is no *a priori* reason for eliminating the possibility of discharge of anions at a cathode. In most plating solutions electrical transport is a very small or even negligible factor in bringing to the cathode the ions to be discharged. The current is usually carried by other ions, and diffusion and convection are mainly responsible for bringing the metal ions to the cathode. There is therefore little reason to expect electrical transport under these conditions to cause appreciable depletion of anions in the vicinity of the cathode. Further, since their concentration in the vicinity of the cathode is maintained by diffusion, the rate of approach of complex anions to the cathode will be a function only of the concentration gradient in the cathode film, which is determined by the rate of depletion at the cathode and the diffusion coefficient of the ion. It is clear, then, that when an ion carries only a small or negligible portion of the current in solution (as is the case with metal or metal complex ions in most plating solutions) its charge has a small or negligible effect on the direction or rate of its motion. The most important factor determining reduction of an ion at the cathode is the cathode potential. It has been shown that at suitable potentials organic molecules or anions are reduced at cathodes[71] with good efficiency, and that an electron transfer mechanism no different from that in plating is involved. There is no reason to believe, therefore, that metal-complex anions are not also reducible at suitable potentials. The reduction of the anion would entail a process of the type:

$$[Ag(CN)_2]^- + e \rightarrow [Ag(CN)_2]^{2-} \rightarrow Ag + 2(CN)$$

This theory has the advantage that it does not require the postulation of a new complex ion in low concentration. The material which is reduced is abundantly present and requires only a suitable cathode potential for its reduction. The instability of the reduction product would be expected, hence its subsequent decomposition would be normal. The only serious objection that has been raised to this theory is the idea of reducing negative ions at a cathode, which has been shown to be not unreasonable. There are many reactions where this seems to be true, e.g., organic reactions, reduction of NO_3^-, and of NO_2^-. *Kasper*[31] believes that chromium plating occurs by direct reduction of $Cr_2O_7^{2-}$ anions, and *O. A. Esin* states that the $[Cu(CN)_2]^-$ is reduced in copper plating.[72]

The stability of silver plating technology is further evidenced by the fact that one of the earliest brighteners employed is the principal one in industrial use today.[73] It is prepared by mixing CS_2 with a portion of plating solution and letting the mixture stand. Portions of this mixture are then added to the bath as needed. It is believed that the active ingredients of this brightener are materials such as thiourea and dithiocarbamates, which are formed by the reaction of CS_2 with the plating solution.[73] These compounds are capable of forming either soluble or colloidal complex compounds with the silver, and their effect may be based on this property.

Complexes in Precious Metal Plating

Gold

Gold plating is done almost exclusively from cyanide solutions, in which the gold is believed[6] to be present only as $[Au(CN)_2]^-$. Except for the presence of phosphates or carbonates which act as buffers,[76] no addition agents are used, since in decorative gold plating the deposits are always so thin that their brightness is that of the base metal. In electrorefining of gold, and where heavy gold plates are required, the acid gold chloride solution is used. Here $AuCl_3$ is dissolved in HCl and the gold is present as the complex $[AuCl_4]^-$. The deposits from this solution are generally coarse-grained and rough and not especially suitable for decorative purposes. Here we find the only use in plating of the large group of complex halides which are known. Metal may be plated from many of the complex halide solutions but usually other systems are superior.[19] There is very little material published on gold plating, and practically no theoretical material is available on the subject. One serious defect of gold plating solutions is their tendency to give rough nodular deposits when fairly thick plates are required. In the event that smooth, heavy gold plating should be needed, there is no doubt that modifications in present solutions will be required to accomplish this in a practical manner.

Platinum

Platinum plating is used industrially for decorative purposes and for the plating of scientific equipment. It is accomplished from highly complex solutions, whose compositions are not very well known. The most widely used solution is prepared by mixing a solution of $H_2[PtCl_6]$ with a solution of $(NH_4)_2HPO_4$. The precipitate of $(NH_4)_2[PtCl_6]$ is then dissolved by adding a solution of Na_2HPO_4 and boiling the resultant solution for a long time. The color changes during boiling from orange-red to a pale yellow owing to the formation of a complex ammine-phosphate of platinum. In this condition the solution is ready for use.[77] The composition or structure of the complex platinum ion in this solution has not been reported.

Another widely used solution is prepared from $[Pt(NH_3)_2(NO_2)_2]$.[78] This salt is a neutral insoluble complex, but on warming in 5% NH_4OH solution it is converted into the soluble $[Pt(NH_3)_4](NO_2)_2$. To this is added NH_4NO_3, $NaNO_2$ and NH_4OH to make a stable plating solution. The solution is operated at a

pH close to 7. An alkaline chloroplatinate solution containing oxalate has been used in England. It is said to give excellent plates but the solution is not completely stable.[82]

Rhodium

Rhodium plating has been used as a permanent finish for reflectors and other applications where a white metal of high reflectance and tarnish resistance is necessary. It is plated from acid solution of complex sulfates, phosphates, or mixtures of these acids. Simple $Rh_2(SO_4)_3 \cdot 12H_2O$ dissolved in water does not give satisfactory plates. Boiling of $Rh_2(SO_4)_3$ with H_2SO_4 solutions forms a complex whose structure has not been determined. An ion such as $[Rh(SO_4)_2]^-$ is a possibility but thus far has not been identified in the solution. The conditions under which the complex is prepared must be rigidly controlled in order to obtain satisfactory results. Rhodium plating solutions are generally made by adding a prepared concentrate of the complex Rh compound (sulfate or phosphate) to a dilute solution of sulfuric or phosphoric acid. It is interesting to note that if the concentrate is added to water a precipitate caused by hydrolysis is formed. This precipitate may then be dissolved on adding acid, but the solution will not plate satisfactorily, since the complex ion was destroyed and not restored by simple solution in acid. A number of alkaline solutions based on complex nitrites have been patented but these are not used to any great extent in this country.

Complexes and Alloy Plating

It is in the deposition of alloys that particular use is made of the most important electrochemical property of complex compounds. It is well known that metals which are far apart in the E.M.F. series cannot be codeposited from simple ion solutions. An attempt to deposit such metals results in the deposition of the more noble one while the less noble metal remains in solution. For example, copper has a standard reduction potential of +0.34 volt and zinc one of —0.76, a difference of 1.1 volts. Since polarization in plating from a $CuSO_4$ solution is no more than 0.2 or 0.3 volt at the maximum reasonable current density, if the copper and zinc are present in approximately the same concentrations, there is practically no possibility of raising the potential of an electrode at which copper is depositing to a value near that at which zinc might deposit. By application of the Nernst equation we find that it is necessary to reduce the copper concentration to about 10^{-38} *M*/l. to bring the reduction potential of copper up to that of a molar zinc solution. It would, of course, be ridiculous to attempt to bring the Cu and Zn deposition potentials closer together by reducing the Cu concentration to any such figure. The potentials are brought together, however, by the use of complex ions. Those who believe that deposition from complex systems occurs by reduction of the simple ions arising from dissociation of the complex, consider that the complexing agent reduces the simple ion concentrations to the point where the metals will codeposit. Due to the serious objections to the idea of deposition from ions present in negligible quantity (as discussed previously) it is more reasonable to consider that the effect of the complexing agents is to produce complex metal ions, whose reduction potentials are closer together than those of the simple ions. The problem of alloy deposition resolves itself, therefore, into one of finding suitable complexing agents for the two or more metals to be deposited, such that the reducible complexes are present in solution in such proportion that their deposition potentials will be close together. If a particular composition of plated metal is desired, the deposition potentials of the reducible ions must have a specific relation to each other, since a larger amount of the one with lower deposition potentials will be deposited, and lastly, all components must be compatible and soluble in the presence of each other.

Brass Plating

Brass plating is widely used for decorative purposes and for bonding rubber to steel. The solution used is a cyanide solution of zinc and copper, containing some ammonia and sodium carbonate. The most important complex ions present are: $[Cu(CN)_2]^-$, $[Cu(CN)_3]^{2-}$, $[Cu(CN)_4]^{3-}$; $[Zu(CN)_3]^-$, $[Zn(CN)_4]^{2-}$, $[ZN(OH)_4]^{2-}$ and ammine complexes. By the titration method, *Pan*[85] came to the conclusion that the major complexes are tricyano copper and tricyano zinc ions, but his procedures and conclusions were strongly disputed (see discussion of article in ref. 85). The ammonia is a reaction product of electrolysis resulting from the decomposition of cyanide. Since its concentration has a vital influence on the composition of the deposit, it is usually added to the bath and kept at some fixed value, so that its formation during operation will not cause variation in the deposit.

Most electrodeposited brass has a Cu:Zn ratio between 7:3 and 4:1. Since the color varies rapidly with composition, it is necessary to control the composition of the deposit very closely. Almost every factor of composition or operating conditions will affect the deposit composition and as a result, good brass plating requires excellent control methods. The Cu:Zn ratio in the solution and the anodes is usually maintained close to that of the deposit (e.g. 4:1) to simplify control of this factor. Since the temperature affects the equilibrium between the various complex ions present, it affects the deposit composition. A 2.8°C. rise in temperature is said to decrease the zinc content by 3%.[84] The ammonia reduces the copper content of the deposit[86] and more important, it is said to reduce the effect on the composition of the deposit of variation of metal ratio in the solution, and of current density variations,[87] thereby making the solution easier to operate. This is probably a result of the different stability of copper and zinc ammine complexes or mixed ammine-cyanide-metal complexes. Specifically, *Clarke*[86] believes that the efficiency of zinc deposition is increased by NH_3, while that of copper is unaffected. Since the pH would affect the zincate, cyano zinc complex equilibrium, it too affects the composition of the deposit. Increasing pH increases the zinc content of the plate.[84] The effect of cyanide on the plate composition is complex and the reports of different authors are not in agreement[86, 88] It is clear that with so many different components all in equilibrium with each other, variation in any factor will cause general changes in the equili-

brium composition and result in deposit variations which in many instances are unpredictable.

Speculum (Tin-Copper)

Another plated alloy which has had wide industrial application, though more in England than in this country, is speculum, an alloy of tin and copper with about 45% Sn and 55% Cu. It has a silver-like appearance and is extremely resistant to tarnishing. Here again the metals are too far apart in the E.M.F. series to expect co-deposition of any appreciable amount of tin with copper, and recourse must be had to complex ion solutions. A red bronze plate has been obtained from a solution of the complex oxalates of the two metals,[89] but the silver-white plate is obtained from a solution of the cyano-copper complex and the stannate complex. This is a cause of the use of a different complexing agent for each metal, and since the components of the solution are compatible and soluble, both metals may be simultaneously deposited so long as a composition is maintained wherein the deposition potentials of the reducible metal-containing ions are fairly close and in the correct relationship to each other. One may consider this solution as a combined stannate tin and cyanide copper plating solution. What has been said previously about these systems applies here also, except insofar as there is mutual interaction. It is known that polarization effects are very different with mixed metals than with either metal alone, that ion activities in the cathode layer are different, and other effects appear, which make it dangerous to predict alloy plating behavior from what is known about the single metal characteristics. It has been confirmed, however, that an increase in pH results in greater stability of the $[Sn(OH)_6]^{2-}$, thereby increasing the deposition potential of the Sn and lowering the Sn content of the deposit. The effect of pH on the equilibrium among the various cyano-copper ions is not very great. Increasing cyanide lowers the Cu content of the deposit in the same manner.[90] In this system the metal ratio in the bath cannot be maintained at the same value as in the deposit. While the Sn:Cu ratio in the deposit is 9:11, in the solution it is about 5:1. The copper concentration in the solution must be kept near the indicated low value so that its deposition potential will have the correct relation to that of Sn for producing the 9:11 deposit. In addition to the primary complexing agents, cyanide and caustic soda, there are sometimes added to the solution varying amounts of tartrate or ammonia. Up to 0.2 g/l of NH_3 reduces the tin content of the deposit, and beyond this concentration NH_3 has little effect. The tartrate seems to aid the corrosion of the copper anodes. Increasing temperature notably increases the tin content and increasing current density decreases it. It should be added that as in tin plating, stannite is harmful to the bath and the same precautions with anode corrosion are observed as described for tin plating.

Terne Plate (Lead-Tin)

Pb-Sn alloys corresponding in composition to terne plate have been electroplated both for corrosion protection and for bearing surfaces. The metal ions for this system need not be in complexes because their standard reduction potentials differ by only 0.01 volt. It is evident then that by rather small changes in concentration the two metals can be brought very close to each other in their deposition potentials, and even made to cross so that the tin would be more easily deposited than lead when the lead concentration is appreciably less than that of tin. The most suitable solution for Pb-Sn alloy plating is the fluoborate solution, for the reasons discussed under lead plating. The bath is a solution of $Pb(BF_4)_2$, $Sn(BF_4)_2$, free HBF_4 and free H_3BO_3.[91, 92] As in lead plating, glue is added to obtain finer grained deposits.

Miscellaneous Alloys

Many alloys have been plated for special purposes such as increased corrosion resistance, bearing metals, abrasion and erosion properties, etc. Among these are: Sn-Zn alloys,[93] said to have exceptional corrosion resistance, and plated from a cyanide-zinc, stannate solution; a ternary alloy of Cu, Sn, and Zn,[94] said to be extremely bright and white in color, also plated from a cyanide, stannate solution; an extremely hard Co-W alloy plated from an ammoniacal tartrate solution,[96] and many others.[95]

Electrocolor and Patternplate

A final illustration of the use of complex compounds in electroplating is an ingenious procedure whereby Cu_2O is deposited at a cathode.[97] In this process the solution is a highly alkaline lactate complex of divalent copper. By reduction at the cathode at low voltage the copper is reduced to the monovalent form. The cuprous ion does not form a stable complex in the solution and so Cu_2O is deposited on the cathode. In this process the Cu_2O may be deposited in uniform layers thin enough to give interference colors, the color depending on the thickness of the layer of Cu_2O, or it may be deposited in thick opaque layers having the characteristic red color of Cu_2O. On controlled reduction of the thicker films to Cu, highly decorative patterns may be produced.

Subjects for Further Study

Although plating solutions can be kept in continuous high-production operation with reasonable success, can be adjusted without too much floundering when they go bad, and in the last 20 or 30 years have been greatly improved in many instances, the knowledge by which this has been done is largely empirical. There are great gaps in our knowledge about the constitution of many of the most widely used solutions and in our understanding of the mechanism of cathodic reduction and deposition. The thermodynamics of complex systems has been studied for many years, but while much valuable information has been obtained, it has only limited application to plating. As soon as an appreciable current passes through a plating solution we are concerned with irreversible conditions and rate phenomena. It is in the field of rate processes that studies have been sparse. Of particular interest would be the study of rate of dissociation of complex ions under various conditions, for which the newly available radioactive isotopes might be a valuable tool. Such studies, correlated with information on polarization and overvoltage, might

greatly assist in improving our understanding of electrodeposition from complex ion solutions. Other techniques, such as the study of optically active complex ions from which metals can be deposited, might also be applied to this problem since their rates of racemization can be easily followed and are related to the stability or dissociation of the ion.

Another field in which studies of complex compounds are required is that of solution purification. With the increasing use of bright plating solutions this is becoming a very serious problem, to which complex compounds might make a valuable contribution. The well-known specificity of certain complex-forming agents with respect to metals, and the very low solubility of dissociation of many molecular complexes would make them particularly suited for the job of removing or sequestering the small amounts of foreign metals which frequently cause troubles in plating.

It is clear that our misunderstanding of the nature of brightener action would be notably improved by a study of the electrical and surface properties of complex compounds formed by the materials used as brighteners.

Lastly, a study of the electrochemical properties of complex compounds of those metals which have not yet been deposited in the pure state from aqueous solutions, such as molybdenum, tungsten, and titanium, etc., might yield clues to the direction required for this long-sought advance of electroplating.

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Abrasive Methods—Surface Treatments—Control
Electroplating—Cleaning—Pickling—Testing

Shop Problems

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Plating Over Leaded Brass

Question: We are using the following cycle for plating 24 kt. gold over naval brass:

1—Clean, rinse, bright dip
2—Copper flash, rinse
3—Gold plate .00003"

We have plated a number of parts successfully, but recently it has been suggested to make these parts of free-cutting leaded brass and we are wondering if any new corrosion problem might be introduced in using the newer material in place of the naval brass.

W. E.

Answer: There is no reason to believe that the substitution of free-cutting brass for naval brass will cause you any trouble in this case. The only difference from the plating standpoint is the existance of more lead in the form of minute particles dispersed throughout the brass, and this should not result in any problems. However, it is suggested that a nickel plate under the gold would be better than the copper, just in case. Inasmuch as your gold plating is sufficiently thick there should not be a problem with the gold color, and the intermediate nickel layer would prevent the possibility of the gold or copper being absorbed into the lead particles over a long period of time.

Hot Lacquering to Prevent Spotting Out

Question: We have recently learned that our competitor is using some method for hot spraying parts to prevent spotting out. Can you tell us how this is done?

T. F.

Answer: One of the commonest steps taken by platers to prevent spotting out of plated parts is baking the parts after they have been plated and rinsed. This baking dries out any residual chemicals trapped in the pores and surface cavities of the metal. If the parts can be removed from the baking oven and sprayed with lacquer while they are still warm, the lacquer will be drawn into the pores as the heated air in these pores contracts through cooling. This will (presumably) cause the lacquer film to cover and thus isolate from the atmosphere any residual chemicals in the pores, and prevent them from absorbing moisture, expanding, and running back out to the surface to cause the corrosion commonly called "spotting out." This process is not to be confused with the newly developed method for hot lacquering wherein the lacquer itself is heated before spraying onto the parts. This latter method accomplishes quite a different thing, and is not connected with spotting out. Some experimenting with a suitable lacquer would have to be done to use the first mentioned method for spotting out prevention.

Season Cracking of Plated Brass Parts

Question: We are running into trouble with some cracking in storage of nickel-chrome plated brass parts. We know it must have something to do with the plating because the same parts finished in baked lacquer colors do not give us any trouble. What could could possibly be the cause? (Nickel and chrome cycle given).

N. B. A.

Answer: There seems to be nothing wrong with your plating cycle as given. Your trouble probably lies in the fact that the brass parts are stressed, probably from any deep drawing operations, which is causing season cracking. The reason the baked lacquer finishes do not show this cracking is because the stresses are relieved during the baking operation. To eliminate this trouble the parts should be given a low temperature stress relief anneal before they are plated. This will not soften the parts, but will eliminate the stresses which are causing your difficulty.

Plating Red Gold on Stainless Steel

Question: I would like to know how to plate red or rose gold on stainless steel. I have tried plating first with copper, but have been told that direct plating onto the stainless without the copper undercoat is possible. Can you give me any details.

E. V. H.

Answer: The only difficulty in plating on stainless steel lies in the preliminary strike required to get good adhesion. Maintenance of a uniform color requires the same attention and adherence to all operating details as color control of gold on any other metal.

After cleaning and rinsing, the stainless parts should be given a three minute strike in the following bath:

Nickel chloride	30-35 oz. gal.
Boric Acid	4-6 "
Hydrochloric Acid	10% by volume

The bath is operated at 20-40 a.s.f. After rinsing, the parts are ready for gold plating. For best color control, it is preferable to use stainless steel anodes in the gold solution, making additions to the bath from concentrated stock solutions.

PR Plating of Bright Silver

Question: Can you give us any information on the use of PR plating to improve the brightness of silver plating from a potassium cyanide bath,

or refer us to any previous work in this field?

W. J. M.

Answer: The only work we know of regarding PR plating of bright silver was mentioned during the discussion of one of the papers presented at the recent Boston Convention of the A.E.S. by *Mr. Frank C. Mesle*, of Oneida, Ltd. His experience was that PR permitted about twice the usual current density for bright plating. Current densities up to 100 a.s.f. were cited.

Blistered Plating of Die-Castings

Question: Lately we have had trouble with blistering while plating zinc-base die-castings. This blistering takes place during the plating process, and most blistering takes place on smooth surface parts. Our cycle is as follows:

1—Degrease
2—Mild alkaline cleaner, direct current
3—Cold water rinse
4—2% sulfuric acid dip for 3-4 seconds
5—Cold water rinse
6—Mild cyanide dip-about 8% NaCN
7—Cold water rinse
8—15-20 second copper strike
9—Cold water rinse
10—Brass plate.

Not all of our castings give trouble, but only certain ones. We would appreciate any suggestions you could make to overcome this trouble.

C. E. W.

Answer: Your problem seems to lie in the cleaning operations. It is suggested that you try a reverse current (anodic) treatment in the mild alkaline cleaner, as this is considered the better treatment for zinc alloys. If your cleaner composition contains silicates, it would be advisable to use a 1-2% hydrofluoric acid dip in place of the present sulfuric acid dip. It is difficult to explain why only certain parts will blister, while the bulk of the production seems to plate satisfactorily. Perhaps it is a question of how much surface metal, which is the soundest and least porous on die-castings, is removed in the polishing or buffing operations that precede the cleaning and plating.

Plating of Silver Alloys

Question: We are interested in the various alloys of silver that can be plated from aqueous solutions. Can you give us any information as to which alloys can be plated and any information on the baths used?

V. F. T.

Answer: The most extensive work in this field was done by *Mathers* and *Johnson*, and was reported in the Transactions of the American Electrochemical Society, Vol. 74. They obtained silver alloy deposits with copper (up to 63% Cu), nickel (up to 74% Ni), iron, cadmium (up to 30%), cobalt, and lead (up to 72% Pb). They also reported on the tarnish resisting properties of the various alloy deposits.

Measuring Thickness of Sprayed Metal Coatings

Question: We have the problem of measuring the thickness of sprayed metal coatings of zinc and aluminum on steel. We have been using the method of stripping a given area, weighing before and after stripping, but the accuracy is not good. Our results always seem to indicate much thinner coatings than actually exist as measured microscopically or with a magnetic type instrument. Even grinding the surface of the sprayed coating smooth before magnetic measurement does not seem to bring the results any closer together. Can you give us any information on this?

W. A. J.

Answer: The discrepancy in the stripping method lies in the fact that the density of the sprayed metal coating is not the same as the density of the pure metal itself or an electroplated coating. Sprayed metal coatings usually have a density of approximately 90% of the density of the pure metal, therefor if you will divide the thickness as calculated in your stripping method by .9 you will get a result that will check very closely with the actual thickness. The actual density depends very much on the actual spraying technique used, and could vary from the 90% figure by a considerable amount.

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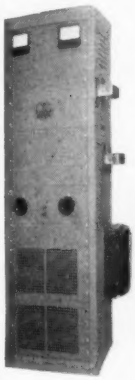
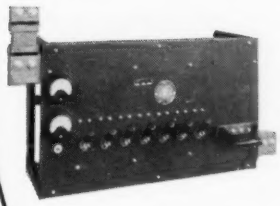
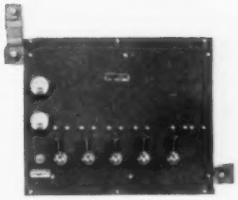
CROWN Equipment



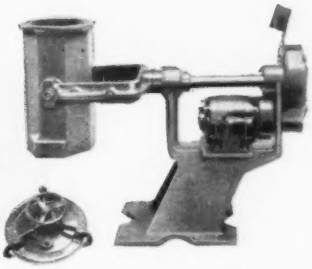
Model 815 Selenium Rectifier



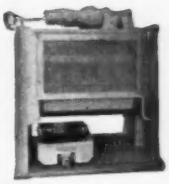
Crown Rheostat with Cut Out Switch



Crown Rheostat

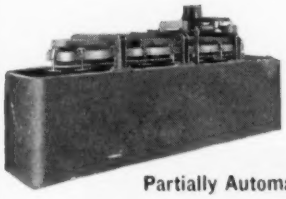


Ball Burnisher

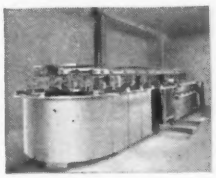


Crown Tumble Finishing Machines

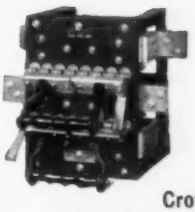
Centrifugal Drier



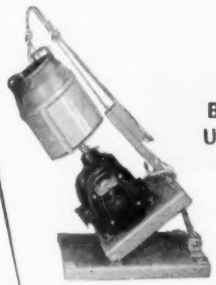
Partially Automatic



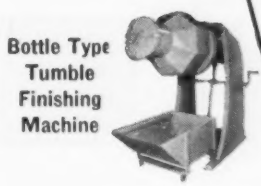
Fully Automatic Plating Machines



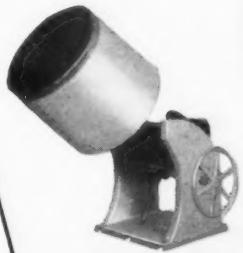
Crown Reversing Switch



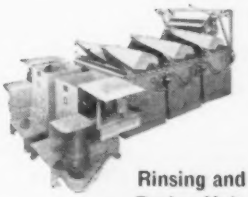
Bench Type Utility Plater



Bottle Type Tumble Finishing Machine



Tilting Type Tumbler



Rinsing and Drying Unit

Crown Disconnect Switch

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PATENTS

Plating Pure Zinc from Zinc-Lead Anodes

U. S. Patent 2,496,996. *D. L. Griffith and E. I. Isherwood, assignors to Hudson Bay Mining and Smelting Co., Ltd.*

In the electrolytic recovery of zinc from a zinc sulphate electrolyte when using an anode of which a substantial proportion is lead, the method of obtaining zinc at the cathode containing less than about .007% of lead comprising introducing into the electrolyte from about 5 to about 20 milligrams of silver per litre of electrolyte and carrying out the electrolysis with such silver present in the electrolyte.

Anodizing Magnesium Alloys

U. S. Patent 2,497,036. *N. H. Simpson and P. R. Cutter, assignors to Consolidated Vultee Aircraft Corp.*

That improvement in forming a protective anodic coating on magnesium and magnesium base alloys, which comprises, electrolytically treating them in an aqueous electrolytic bath containing sodium silicate and an alkaline base, the quantity of sodium silicate used being 2 to 3% by volume and that of the alkaline base being 21 to 25% by weight, said bath also containing an additive of substantially .05 to 10.00% by weight of a hydroxy organic compound taken from the group which consists of glycerol, dextrose, cresol, phenol and phenolsulfonic acid, which forms polar groups and retards the formation of gases to effect substantially uniform oxidation on the surfaces of the metal being coated to produce a uniform coating, said additive becoming a part of the coating formed.

Aluminum Coating of Metals

U. S. Patent 2,497,119. *C. G. Fink, assignor to Alwac Co., Inc.*

A method of coating basis metals, comprising continuously introducing streams or jets of hydrogen below the surface of a molten bath of aluminum, in quantity in substantial excess of the quantity capable of being absorbed by the molten aluminum, and maintaining said quantity, so that there is always a surplus of hydrogen in the bath, and immersing ferrous basis metal in an ordinary state, capable of absorbing hydrogen from the molten bath, in the molten bath of aluminum containing said excess of hydrogen.

Improved Porous Chrome Plating

U. S. Patent 2,497,591. *G. Dubpernell, assignor to United Chromium, Inc.*

A method of minimizing patchiness in porous chromium consisting essentially of electroplating chromium predisposed to the formation of porous chromium in a plating bath having CrO_3/SO_4 ratios from about 25 to 1 to 150 to 1, at temperatures of about 77° F. to 160° F., and current densities from about ¼ to 16 amperes per square inch appropriate to the temperature of the bath, and etching the said chromium electrodeposits to form porous chromium, characterized by continuing the passage of current in the plating bath, in the end part of the plating period, to the chromium already deposited, at a reduced cathodic current density corresponding to a plating current efficiency to 6% to 0% for 1 to 10 minutes.

Bright Cadmium Plating Bath

U. S. Patent 2,497,806. *L. Weisberg, assignor to The Lea Mfg. Co.*

A bath for plating bright cadmium consisting of an aqueous cadmium cyanide solution containing alkali metal cyanide and a roasted water extract of coffee containing substantially all of the non-volatile, water-soluble constituents of roasted coffee, said extract being in amount sufficient to impart a bright surface to cadimum deposited from the bath.

Chromate Treatment of Zinc or Cadmium Plating

U. S. Patent 2,497,905. *C. W. Ostrander, assignor to Rheem Mfg. Co.*

The process of forming a visible corrosion resistant coating on a surface of zinc or cadmium or alloys consisting essentially thereof which comprises subjecting the same to an aqueous acidic solution having a pH between about 0.5 to 2.0 consisting essentially of a compound selected from the group consisting of chromic acid and soluble salts thereof; a compound selected from the group consisting of phosphoric acid and soluble salts thereof; a compound selected from the group consisting of nitric acid and soluble salts thereof and a compound selected from the group consisting of sulfuric acid and soluble salts thereof until a green coating is formed, the chromate ions being present in amount of between about 20 g./l. and 40 g./l. of chromic acid, the phosphoric ions being present in amount of between about 1 and 15 cc./l. of phosphoric acid and the remaining mineral acids being in amounts by volume to produce a pH within about 0.5 to 2.0, and after said treatment heating the coating to increase its abrasion resistance.

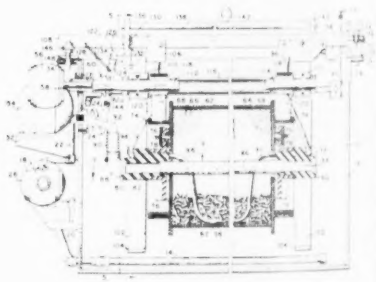
Indium Plating Bath

U. S. Patent 2,497,988. *D. F. Green and J. E. Salmon, assignors to Vanderveil Products, Ltd.*

An aqueous indium cyanide dextrose electrolytic bath for electrodepositing indium consisting of from 5 to 40 grams per liter of indium, 5 to 40 grams per liter of dextrose with a ratio by weight of dextrose to indium of 1 to 1, a cyanide of the group consisting of sodium cyanide and potassium cyanide of from 1 to 5 times the weight of indium present and the corresponding hydroxide of the above cyanide in quantities of from 6 to 135 grams per liter.

Barrel Plating Machine

U. S. Patent 2,498,128. *M. Lang, assignor to Frederic B. Stevens, Inc.*



In an electroplating apparatus: an electrolyte holding tank; a horizontal member resting on the edges of said tank; a frame carried by said member; downwardly extending legs carried by said frame; a workpiece container rotatable between said legs; a horizontal countershaft journaled in said frame and means supporting said container from said shaft and for driving said container by said shaft; a drive shaft on said tank in alignment with said countershaft but spaced therefrom; clutch means carried by said shafts and yieldingly urged into

driving engagement; lifting means associated with said frame for lifting the same together with said container from said tank, and means responsive to the exertion of lifting force on said lifting means for automatically disengaging said clutch members.

Transparent Anodic Conversion Coatings on Zinc Alloys

U. S. Patent 2,499,231. *J. E. Stareck, assignor to United Chromium, Inc.*

A method of making surface conversion coatings on zinc, which are formed by passing current at 2 to 50 amperes per square foot to the zinc surface connected as anode, immersed at room temperature in an aqueous solution consisting essentially of a soluble chromate and a silicofluoride auxiliary acid radical in a proportion of Cr^{VI} to SiF_6 within the range 20:1 to 60:1 and having a pH between 3 and 7, transparent so as to exhibit the color of the underlying metallic zinc, which comprises soaking articles having said surface conversion coatings thereon in hot water until the coating becomes transparent.

Pickling Magnesium Alloys

U. S. Patent 2,499,269. *H. K. De Long, assignor to The Dow Chemical Co.*

The method of pickling an article of magnesium or magnesium-base alloys containing at least 85 per cent of magnesium which comprises immersing the article in an aqueous solution of aluminum chloride having a concentration of about 80 to 165 grams of $AlCl_3$ per liter of solution and a temperature between about 10° and 60°C. for about 5 seconds to 30 minutes, rinsing, and drying.

Inhibitor for Hydrochloric Acid

U. S. Patent 2,499,283. *H. A. Robinson, assignor to The Dow Chemical Co.*

A composition for treating a ferrous metal surface comprising 5 to 25 per cent of HCl, 0.1 to 2 per cent of a water-soluble organic ring nitrogen-base selected from the group consisting of acridine, pyridine, quinolines and their homologues, and 0.1 to 2 per cent of phenyl hydrazine, the balance being water.

Polishing Wheel

U. S. Patent 2,499,643. *S. Hays.*

A polishing wheel including in combination, an abrasive sleeve forming the peripheral surface of the wheel, a stretchable elastic band disposed within said sleeve, a plurality of wheel segments disposed within said band with the outer peripheral surface of each of said segments immovably attached to the inner peripheral surface of said band, and means to exert sustained pressure on each of said segments so as to cause movement thereof in a radially outward direction thus expanding said band and accomplishing an effective frictional bond between said band and said sleeve, said means being provided with a spindle receiving bore and adapted to exert sustained pressure for being compressed against a spindle within said bore.

Descaling Stainless Steel

U. S. Patent 2,499,764. *P. G. Mabus, assignor to Armco Steel Corp.*

The method of heat-treating stainless steel in the substantial absence of detrimental scale formation, comprising in combination, the steps of converting a surface layer of the metal to the black oxide thereof by immersion in a bath consisting of one or both of the group molten sodium dichromate and molten potassium dichromate, thereupon heat-treating the metal at elevated temperatures and in oxidizing atmosphere ordinarily causing scale formation, and then chemically removing the black oxide down to the underlying metal by immersing the coated steel in a descaling bath.

Molybdenum Plating Bath

U. S. Patent 2,499,308. *L. F. Yntema and M. J. Ksycki, assignors to St. Louis University.*

An electrolyte for the electrodeposition of molybdenum comprising an aqueous solution of a molybdate compound and a concentration of fluoride ion at least several times greater than said molybdate compound.

Spray Phosphating of Aluminum

U. S. Patent 2,500,673. *R. C. Gibson and W. S. Russell, assignors to Parker Rust Proof Company.*

A method of coating metal surfaces with a phosphate coating where said surfaces consist predominantly of aluminum which comprises spraying on to said surfaces a solution containing acid phosphate and fluoborate and an oxidizing agent as its essential active ingredients and maintaining the balance of the solution by adding a neutralizing sodium compound and acidic fluoride in amounts to combine with aluminum and form Na_3AlF_6 and remove excess aluminum from the solution.

Galvanizing Method

U. S. Patent 2,501,262. *R. L. Carhart and C. A. Schacha, assignors to The American Steel and Wire Company.*

The method of applying a molten zinc coating to a ferrous article which comprises applying to the article a molten liquid consisting of zinc, ammonium chloride and tin skimmings, the amount of tin skimmings being between 0.6 and 2.3% of the weight of the zinc, and the amount of ammonium chloride being between 2 and 6.4 times the weight of the tin skimmings, and thereafter cooling the coated article to solidify the metal coating thereon.

A PLATING SUCCESS STORY

(*Concluded from page* 65)

use by all progressive job platers. Harding Mfg. is very active in the *National Association of Metal Finishers*, and George Harding was one of the originators of this organization.

After a job ticket is attached to the incoming raw stock, the plating foreman is given a copy of the ticket with delivery date. He then fits the job into his schedule and plates when necessary. If the work must be plated to specifications, his ticket will so state, and this work must then be laboratory checked during the run and given their OK before shipment is made.

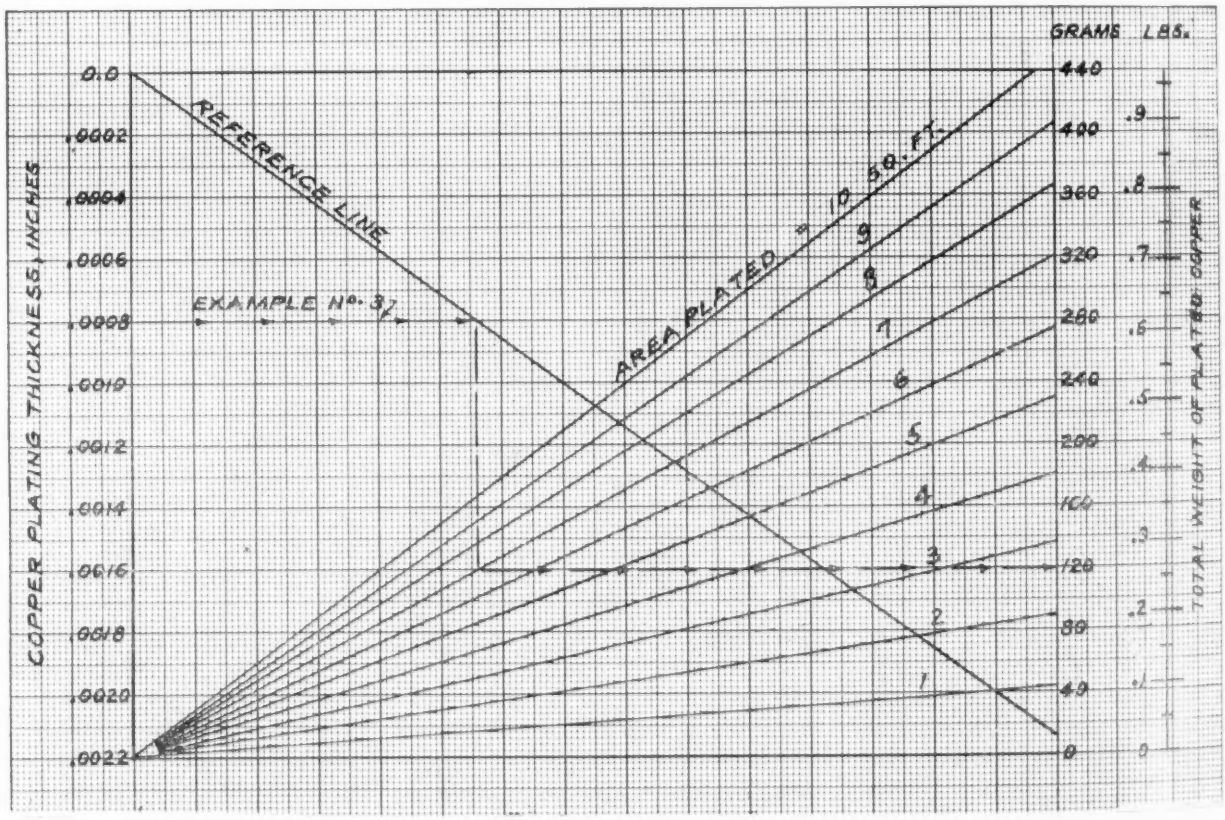
After finishing, the stock is moved to the shipping department where it is stored in a room entirely separate from all plating operations and chemical storage. This insures that the work will not be stained or discolored by plating or chemical fumes. Stock is stored here until finally shipped.

Harding boasts a well equipped plating and research laboratory where a full time chemist performs the routine daily analyses necessary to the proper functioning of a plating shop.

Sound business judgment, coupled with progressiveness, technical and production control, and quality workmanship have thus made a place for this firm in the highly competitive job plating field.

Calculating Metal Cost in Copper Plating

With the aid of the chart below it is a simple matter to calculate the metal cost of depositing a given thickness of copper on a known surface area. The example shown by the dashed line illustrates the method for calculating the total weight of copper used in plating .0008" of copper on a surface area of 7 square feet. The total weight of copper is then multiplied by the present price for copper anodes to get the total cost. For areas larger than 10 square feet simply multiply by the proper factor.



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Recent Developments

New Methods, Materials and Equipment for the Metal Finishing Industries

Chromic Acid Recovery from Rinse Water

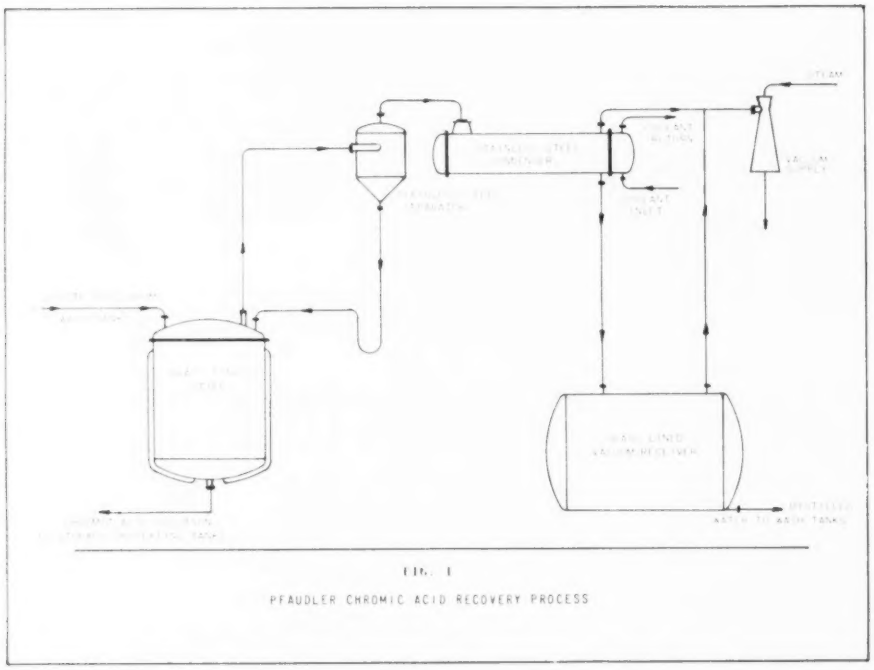


FIG. 1
PFAUDLER CHROMIC ACID RECOVERY PROCESS

The Pfaudler Co., 1000 West Ave., Dept. MF, Rochester 3, N. Y.

This firm, one of the oldest manufacturers of glass-lined processing equipment for the chemical industries, announces their new chromic acid recovery system for recovering valuable chromic acid and preventing stream pollution. The system operates on the principle of concentration by evaporation, and in addition to recovering the chromic acid it will deliver large quantities of distilled water for other plating room uses. Because the system operates under vacuum, with low boiling point of the water in the recovery still, evaporation is hastened, corrosion is lessened, and the heat-up time is shortened. Samples of the concentrated liquid may be obtained at any time during the operation. The still is lined with glass, and other parts of the system are made of stainless steel. The system is offered complete and ready to operate in still sizes of 200-300-500-1000 gallons. Special sizes can be made to order. Complete details may be obtained by writing to the above address.

Non-Sludging Aluminum Etching Compound

Special Chemicals Dept., Pennsylvania Mfg. Co., Dept. MF, 1000 Widener Bldg., Philadelphia 7, Pa.

Pennsalt AE-18, a new, highly concentrated alkaline compound for etching aluminum without forming hard sludge deposits on the bottom of the etching tanks is now being offered by the above firm.

The new etching compound is the result of considerable research at Pennsalt's Whitemarsh Research Laboratories to develop a product which is claimed to give a bath of long life, assure uniform etching, and at the same time avoid the rock-like sludge deposits. Research work was followed by extensive field tests.

Packaged in a 300-pound non-returnable drum Pennsalt AE-18 is recommended for use in concentrations of 5-7 oz./gal. of water at temperatures of 140°-150°F. Depending upon the degree of etch desired, the parts may be immersed for 30 seconds to 10 minutes, followed by rinsing in a clear water dip or spray.

A titration chart and other information may be obtained by writing.

Wax Coating for Metals

S. C. Johnson & Son, Inc., Dept. MF, Racine, Wisc.

A new coating that provides unusual protection against rust and corrosion for metal surfaces has been developed by this firm. This new wax gives aluminum, steel, brass, and other ferrous and non-ferrous metals a dry coating that is resistant to salt spray, high humidity and hazards of outdoor exposure, it is claimed.

Aluminum window frames treated with the new wax were undamaged after more than 300 hours in a 20 per cent salt spray test conducted in compliance with strict American Society of Testing Materials requirements, it is claimed. Similar untreated aluminum strips were heavily corroded after the same exposure. Low carbon steel panels coated with the special wax showed no rust after being exposed to 100 per cent relative humidity at 100°F. for 300 hours and in an exposure test the wax gave adequate protection to steel after five weeks in outdoor, winter weather, according to the firm.

In addition to its unusual protective property, the wax dries tack free in less than ten minutes after application, is easy to apply, and is said to give excellent mileage (approximately 2,000 to 2,500 square feet per gallon).

The wax can be used on any metals to which shellacs or varnishes are

now applied, but unlike these coatings, it is claimed not to discolor in time or become brittle or chip several months after it is applied. At the same time the wax is not gummy, sticky or greasy, as are oil-base coatings.

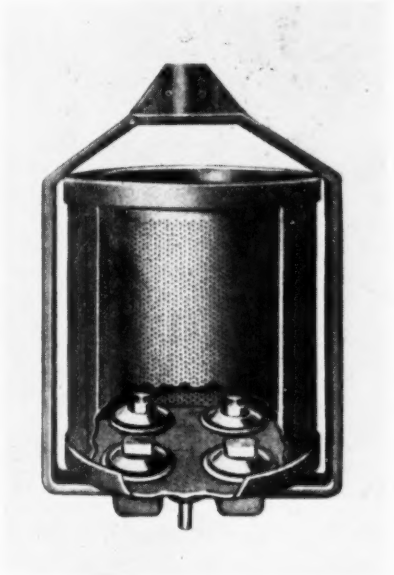
The protective wax coating need not be removed before painting over metal surfaces. Paint can be applied directly onto the wax with no appreciable difference in drying time or adhesion, it is claimed.

Improved Plating Barrel Provides Higher Currents

Daniels Plating Barrel & Supply Co., Dept MF, 129 Oliver St., Newark, N. J.

The above firm is pleased to announce an improvement on all standard type OLS plating barrels.

The OLS contact frame (pictured

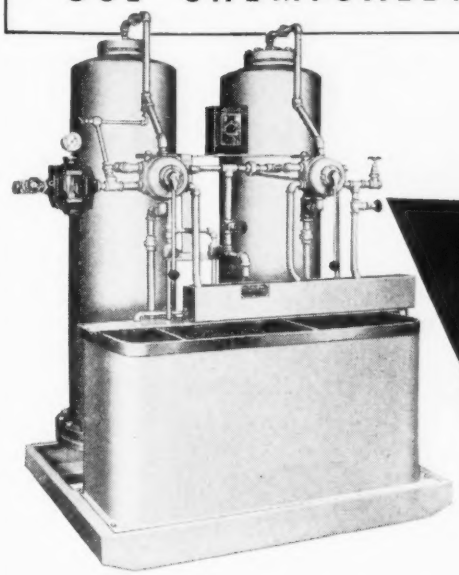


here), which supports their standard perforated cylinder and carries current to the plating parts through the chrome plated contact studs, has heretofore been made of cast iron and insulated by semi-hard homogeneous rubber. Recently, these contact frames have been produced of cast aluminum and insulated as before. This change has introduced some very notable advantages: more current is carried directly to the work, less internal resistance, equal strength and rigidity, and less operator fatigue.

Since aluminum has greater conductivity than cast iron, the current passes easier and faster directly to the plating load. By using the aluminum contact frames together with various other component parts of aluminum, they are able to produce this No. 4 OLS with only two counter weights,

Eliminate Hot-Rinse Stains Unwanted Precipitates

USE CHEMICALLY PURE WATER



only a few cents a thousand gallons with . . . .

INDUSTRIAL Water Demineralizers

A Two-Bed INDUSTRIAL Water Demineralizer. Standard two- and four-bed units available with capacities of 200 to 1000 gph. Special units of any capacity engineered to requirements.

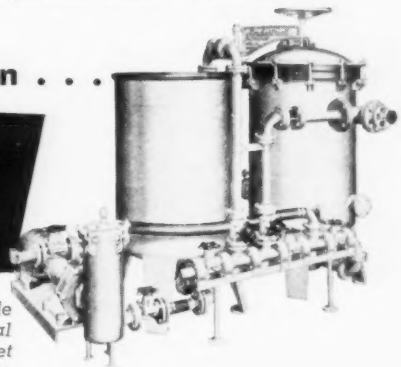
and it's as simple as it looks . . .

besides the extremely low cost, there is nothing complicated about getting the chemically pure water with Industrial Demineralizers. Raw water is passed through either two or four beds of ion-exchange resins and it comes out free of the dissolved mineral salts. No still, heat, steam, or cooling water is needed—keeping space requirements relatively small.

And it's simple to get the complete facts for your case. Send us a water analysis and let us know how much water you have to treat and the gallons per hour needed. We can then give you the whole demineralizer story including estimated costs, equipment required, performance data, etc. for your requirements.

for solution clarification . . .

use an INDUSTRIAL Filter



100 to 15,000 gallons per hour. Portable and stationary models. Standard or special filtration systems engineered to meet unusual requirements.

Write for full information and recommendations

FILTERS Pressure Type · PUMPS Centrifugal · CORROSION TESTING APPARATUS Salt Fog • Humidity

INDUSTRIAL FILTER & PUMP MFG. CO.

5906 Ogden Avenue
Chicago 50, Illinois

RUBBER DIVISION Vulcanized Linings • Molded Products · WATER DEMINERALIZERS

CASE HISTORIES

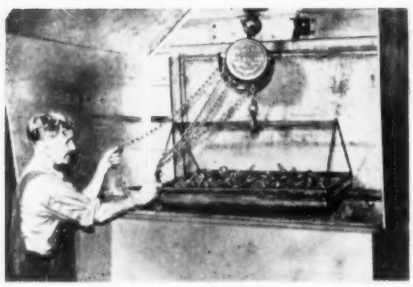
Actual Reports Available on Request

Pre-Cleaning Time Cut from 15 to 5 Minutes in Job Plating Shop

Problem: Removal of coolant and cutting lubricants, chips and shop dirt from small screw-machine parts prior to alkaline platers' cleaning.

Former Method: Baskets of parts placed in vapor degreaser for 15 minutes to remove soil.

Present Method: Baskets of parts are immersed for 5 minutes in Magnusol Pre-Cleaning solution heated to 175°F. (The Magnusol emulsion is made by mixing 1 gallon of Magnusol with 10 gallons of mineral spirits and 20 gallons of water.) After 5 minutes to soak, the parts are given a quick water rinse and then placed in the alkaline platers' cleaning cycle.



Advantages: Using the hot Magnusol emulsion, the pre-cleaning cycle has been shortened from 15 to 5 minutes. Parts are completely cleaned, ready for the subsequent cleaning and plating operations.

The Magnusol method is low in cost and can be readily incorporated into many present cleaning cycles with relatively little trouble. Rejects due to improper cleaning can be literally reduced by the hundreds. Why not consider it for your shop? For information write Magnus Chemical Co., 11 South Avenue, Garwood, N. J. In Canada—Magnus Chemicals Limited, Montreal. Service representatives in all principal U. S. cities.

yet lifting power required for loading and unloading is less than before.

Corrosion Resistant Polyethylene Linings

Houghton Laboratories, Dept. MF, Olean, N. Y.

A method of flame spraying polyethylene coatings on steel tanks, tank cars and processing equipment has been perfected by the above firm. Claimed to give greatly improved corrosion protection, the Houghton flame-spray process uses no solvents and applies coatings in thicknesses from 1/32" to ¼".

After the tank to be coated has been sand blasted, polyethylene in powder form is blown through specially designed flame spray equipment. Deposited on the tank in melted form, the polyethylene sets up to a tough, non-porous film which has unusual resistance to practically all chemicals and corrosive materials, it is said.

According to the manufacturer, this radically different method of applying protective coatings eliminates danger of pin holes and other defects which might permit corrosion to start. The resulting odorless, taste-free, completely non-toxic coating is recommended for use in chemical, food, petroleum and metal workng industries wherever severe corrosion problems exist.

Considerable laboratory and pilot plant data are available on the process which has been in development for two years. Houghton Laboratories will coat existing equipment, supply new coated tanks or furnish equipment and personnel for coating field applications.

Hand Dispenser for Adhesive Tapes

Minnesota Mining and Mfg. Co., Dept. MF, 900 Fauquier St., St. Paul 6, Minn.

A new hand dispenser for dispensing lengths of tough tear-resistant filament tapes was announced recently by the above firm.

Main feature of the new dispenser is a razor-sharp cutting edge. A thumb-operated trigger presses the cutting blade against the tape to make the cut. When the trigger is released the blade retracts so that it cannot cut accidentally.

Dulled blades, the announcement pointed out, can be changed as easily as safety-razor blades — loosen the screw at top of dispenser, slide the old blade out, insert the new blade, and tighten the screw. Five replacement blades are included with each dispenser.

The dispenser can be used with tape rolls up to 72-yards in length, and accommodates tape widths from ½ to 1 inch.

Both the dispenser and filament tapes are available from paper jobbers nationally.

Oxidizing Liquid

Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.

A liquid which is claimed to produce oxidation rapidly and with better

results than ordinary chemicals has been announced. By adding ¼ fluid ounce of concentrated H-VW-M Oxidizing Liquid to each gallon of water, an oxidizing solution may be made for copper, bronze and silver. This solution will not deteriorate and there is no waste, according to this firm. Solutions may be used hot or cold, but faster operation is obtained when hot.

Dipper for Acids

Stokes Molded Products, Dept. MF, Inc., Trenton 4, N. J.

A greatly increased safety factor in handling corrosive liquids is made possible by a new type dipper for use with a wide variety of chemicals, according to the manufacturer, Stokes

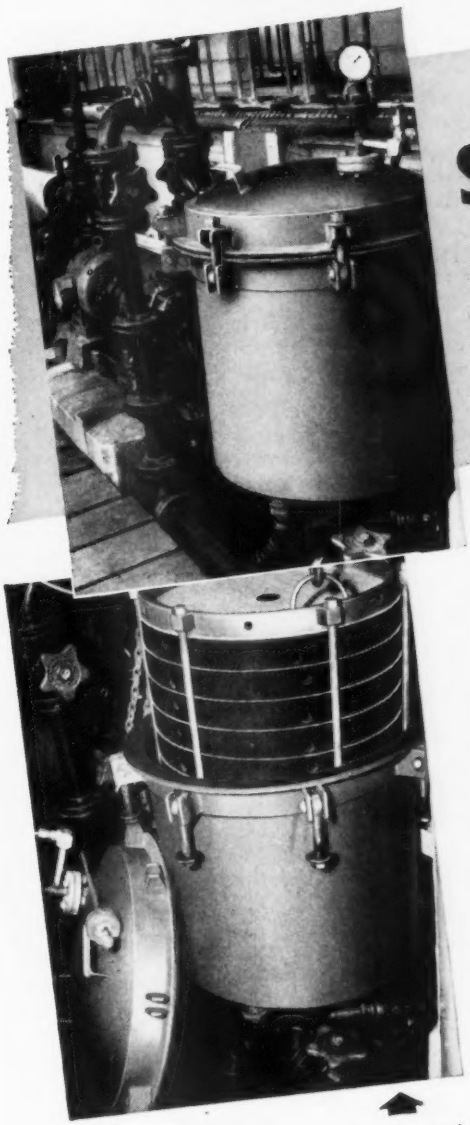
Molded Products, Inc. The *Stokolite* L-44 dipper is being introduced, after two years of testing in laboratories and chemical plants, as a companion to the *Stokolite* pail which the company put on the market last fall.

Made of *Stokolite* L-44 compound, which has a base of virgin rubber, the new dipper is streamlined for lightness and has an efficient pouring lip and a well reinforced handle. The nature of the material gives it unusually high resistance to shock, abrasion, heat, and chemical corrosion and renders it practically indestructible.

Chemicals with which it has been successfully tested for corrosion resistance include an extensive list of acids, salts, bases, and organic materials under varied atmospheric and temperature conditions.

The *Stokolite* L-44 dipper is made in one-quart and two-quart sizes. Additional information may be obtained by writing.

No repairs or maintenance in over 17,000 hours of 'round-the-clock operation



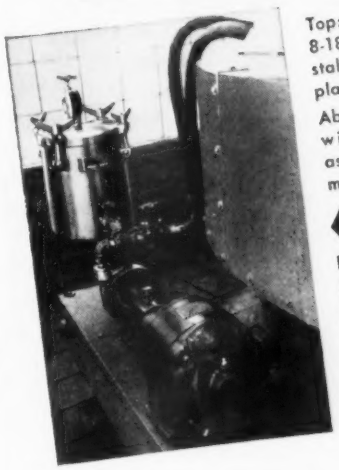
. . . yet this SPARKLER Horizontal Plate FILTER is still going strong

The kind of service Sparkler Horizontal Plate Filters have given the Gillette Safety Razor Company—efficient and trouble-free, even under most extreme conditions—is the kind of service that is vital to *every* filtering operation.

For example: A rubber-lined Sparkler Model 8-18 filter is used by Gillette in the continuous filtration of a 1000-gallon bright nickel plating solution. Now operating for approximately two years, this filter has been on a 24 hours a day, 7 days a week schedule — without any loss of operating time for repairs or maintenance. Also used in periodic batch carbon treatments of nickel solutions this unit, according to Gillette technicians, consistently delivers a brilliantly clear effluent, even though the plates may be packed solid.

Another Sparkler Filter employed by Gillette is a Model 8-6, stainless steel, portable unit. Used exclusively for cyanide type plating solutions, this Model 8-6 has proved particularly valuable for Gillette's gold plating operations since the patented Sparkler Scavenger Plate assures minimum loss of precious gold solution. Now operating almost six months for at least 2 hours daily, its performance has been satisfactory in every respect.

Top: Sparkler Model 8-18 filter shown installed in Gillette's plating department. Above: Same filter, with filter plate assembly being removed for cleaning



Left: Sparkler Model 8-6 stainless steel filter. This portable unit is used by Gillette to filter gold plating solutions.

Our Engineering Department (with more than 25 years' experience in every phase of filtration) is available for consultation without charge.

SPARKLER MANUFACTURING CO.
MUNDELEIN, ILLINOIS

Announcing

An Important Merger...

DARCO CORPORATION
ATLAS SUBSIDIARY

becomes

DARCO DEPARTMENT

ATLAS POWDER COMPANY

Darco Corporation, formerly an unconsolidated subsidiary, is now an integral part of Atlas Powder Company. Present Darco personnel and facilities—manufacturing, sales, and research—are continued in the Darco Department.

Darco plant expansion at Marshall, Texas, is being pushed to completion. With this added capacity—backed by Atlas Powder Company's resources and extensive research, development and engineering facilities—Darco is set to maintain its position as a leading manufacturer of activated carbons for the refining of cane, beet and corn sugars, for the purification of chemical products, vegetable oils and fats, water supplies, textile chemicals and dry cleaning and electroplating solutions.

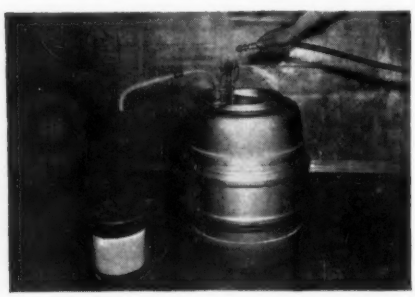
DARCO

DARCO DEPARTMENT
ATLAS POWDER COMPANY
Darco General Sales Offices
60 East 42nd Street, New York 17, N. Y.

Air Pump for Stainless Steel Drums

General Scientific Equipment Co., Dept. MF, 2700 W. Huntingdon St., Philadelphia 32, Pa.

Safe and convenient transfer of acids and other liquids from stainless steel containers is now possible with



the GS No. 17 pump. Liquids flow smoothly and stop instantly, it is claimed. They come in contact only with the corrosion-resistant tube.

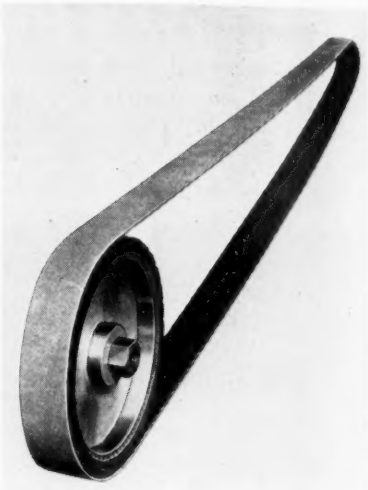
The GS No. 17 pump is fitted with a safety valve for air line pressure and a hold down clamp to secure the pump into the container, together with 25 feet 3/8" air hose with male or female coupling and chuck attached.

Lead tubes are suitable for sulphuric, hydrochloric, hydrofluoric acids and many others. Saran plastic tubes are recommended where the pump is to be used in nitric, muriatic, citric, phosphoric, acetic, bleaches, peroxide and others.

These safe pumps are essential wherever acids and corrosive liquids are handled . . . in industry, laboratory, plating-room, battery manufacturers. Nationally known chemical manufacturers as well as many specialty establishments find them an inexpensive must for safety.

Polishing Belt Can be Re-Coated Many Times

The Industrial Lubricants Co., Inc., Dept. MF, 14459 Wildemere, Detroit 6, Mich.



This firm has recently been appointed distributor for the new Rayon-Resin polishing belt. According to *Mr. A. J. Weismiller*, president of the company, the new belt is the result of years of development and research, and is unlike any other polishing belt on the market. During extensive tests, Rayon-Resin belts have been used and reset in excess of 650 times, it is claimed. There has been no raveling and stretch or shrinkage has been less than 2%, according to the firm.

The full production life of the belt has not yet been determined, but under average conditions this firm estimates they will last in excess of 1,000 set-ups.

The new Rayon-Resin polishing belts are of a patented construction. The pulley side is Neoprene, vulcanized to the rayon polishing side. A special splice is used to join the belt which insures absolutely smooth running operation without kick. Belts are available from 2" to 40" widths and from 96" to 168" lengths.

Karbate Heat Exchangers

National Carbon Div., Union Carbide and Carbon Corp., Dept. MF, 30 East 42nd St., New York 17, N. Y.

Recently announced by the above

firm is their new Series 240A Karbate Brand Impervious Graphite shell-and-tube heat exchangers.

The new, larger, standard 240A heat exchangers, similar in construction to the Series 70A and providing 71 sq. ft. of heat exchange surface, possess all of the recognized advantages of Karbate brand equipment, such as chemical resistance to practically all corrosive fluids, resistance to severe

thermal shock and high heat transfer rates, it is claimed.

Catalog Section M-8801.1 contains complete specifications, sectional dimension drawings and ordering information for the new Series 240A Karbate Brand Heat Exchangers. A copy may be obtained by writing.

Calculating Device for Laboratory Computations

Coleman Instruments, Inc., Dept. MF, 318 Madison St., Maywood, Ill.

The Coleman Chemputer is a new convenience for the busy laboratory chemist or technician. Based on equipment originally developed for aerial navigation, it consists of a pair of sliding scales plus a hairline finder.

A single setting of the scales will instantly and accurately solve any problem of simple proportion—will calibrate any instrument or analytical method yielding linear data, according to the firm. Results are read directly on the scale without preparing tables or curves.

Chemists and laboratory technologists will find the Coleman Chemputer valuable because it:

1. Establishes any linear calibration instantly.
2. Retains such calibrations for future use.
3. Signals potential errors in standard data.
4. Can be simply reset to provide complete new calibrations for changes in standard data or methods.

FASTER FINISHING

WITH

Hammond

STRAIT-LINE AUTOMATICS

ROTARY AUTOMATICS

JUNIOR AUTOMATICS

There are ten new Junior Automatics in the Hammond Line, to be used with polishing or buffing wheels or with abrasive belts. Model E2PF shown.

Users of Hammond Automatics report 2000 pieces or more per hour, more uniform, better finishing, less operator fatigue and specially, *lower costs.*

SEND SAMPLES: Send us one finished and several rough samples. You will receive a complete Engineering Report and Production Analysis without obligation.

Hammond of KALAMAZOO

Good Machinery Since '82

Hammond Machinery Builders INC.

1601 DOUGLAS AVENUE ★ KALAMAZOO, MICHIGAN, U. S. A.

Plastic Coated Tubing for Corrosive Atmospheres

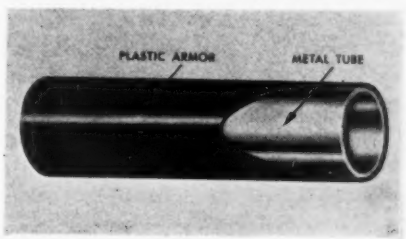
Samuel Moore & Company, Dept. MF, Mantua, O.

A new low-cost corrosion-proof instrument tubing made of metal with a 1/32-inch coating of extruded thermoplastic is announced by this firm.

Known as Dekoron tubing, it is said to be especially useful in laboratories, chemical or food processing plants, refineries, or other plants where there is a corrosive atmosphere. The manufacturer claims that the thick, chip-proof plastic coating of the Dekoron tubing, made by a patented extrusion process, grips the tube tightly and completely protects the tubing from corrosion danger. The plastic coating is immune to moisture, salt air, oils, acids and alkalies, it is claimed.

Literature and sample lengths of Dekoron tubing are available on request.

Available in ¼ and ⅜-inch diame-



Shipped Complete, Tested, Ready-to-Operate!

At left: Electrically heated, automatically controlled oven for baking insulating varnish on coils, stators and other parts at Internat'l. G. E. Service Shop, Mexico City.

At right: Steam heated, 22 foot long oven for removal of moisture from paper filters used in acetate yarn manufacture at Tennesse Eastman Corp., Kingsport, Tennessee.

READY TO USE when they reach your plant, production-size ovens are built, tested and shipped complete from the KIRK & BLUM plant. Your production through the oven starts just as soon as necessary connections are made . . . there's no tie-up for erection, testing or adjustment in your plant. You save time, money and avoid production delays.

From mammoth conveyor ovens for high production to the smallest of laboratory units, KIRK & BLUM builds many types of industrial ovens for a multitude of uses. Typical installations are shown in "Industrial Ovens" Booklet. Write for your copy today. The Kirk & Blum Mfg. Co., 2859 Spring Grove Ave., Cincinnati 25, Ohio.

KIRK AND BLUM
INDUSTRIAL OVENS

ters. Dekoron tubing has advantages over stainless steel and other expensive alloys in that it can be bent easily, like ordinary copper tubing, and the plastic coating also serves as color coding for the line.

Demagnetizing Coils

General Electric Co., Special Products Div., Dept. MF, Schenectady, N. Y.

A recent addition to the products of this G. E. division is an improved demagnetizing coil that can be used for demagnetizing steel articles on a conveyor belt prior to washing, spraying, etc. The coil is rated at 110 volts, 60 cycles, and has a central opening 4½" x 8½", and will take stock up to 8" wide. Grease, dirt, scale, or rust are said not to affect the action.

Free Rinsing Agent for Spot-Free Drying

The Miskella Infra-Red Co., Dept. MF, E. 73rd & Grand Ave., Cleveland 4, O.

This firm has recently announced a material called Dri-Water, which when added to rinse tanks is claimed to cause most of the water to flow off the parts, leaving only a very thin fog to be removed in the final drying operation. The firm claims that a final, low-capacity infra-red oven is all that is required to remove the last traces of water and promote spot-free dried parts.

The material is supplied in the form of a liquid concentrate that is added to the tank in the proportion of 1 oz. to each 10 gallons. It can be sprayed on the parts, and means are available for introducing it continuously into the running water feed to the rinse tanks in the proper proportion. It can be used in either hot or cold water. The cost of treating rinse water with Dri-Water is said to be about 1 cent per gallon.

Further information and sample processing will be furnished by writing to the above address.

Water Dispersible Buffing and Coloring Compositions

Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.

The cleaning of buffed and polished metal products of complicated shapes, and the removal of buffing and coloring compositions which pack into recesses and tight places, usually make it necessary to go through several cleaning operations to provide a presentable finished product. For that reason, the above firm has developed a new water-dispersible buffing and coloring composition which they have designated as No. 4-S-10.

This composition is easy to clean in aqueous solutions, using a mild alkaline cleaner with or without current, it is claimed. It is especially useful in work with deep filigrees which tend to trap composition into tight, hard masses, according to the firm.

No. 4-S-10 is a general purpose material for color buffing all non-ferrous metals except nickel.

Removable Polyethylene Linings for Drums and Crocks

Enley Products, Inc., Dept. MF, 254 Pearl St., New York 7, N. Y.

Heat-sealed, removable, lightweight polyethylene linings instantly convert ordinary steel drums into efficient corrosion-resistant containers for corrosive solutions such as chromic acid, nickel plating baths, etc. No need to have extra, expensive and space-consuming spare tanks. Useful for filtering, treating solutions, or as storage while cleaning main tanks. Tough, chemically-inert polyethylene resists temperatures up to 200°F and all ordinary acid, cyanide, or alkaline solutions. Ready-made liners available for 55, 32, 15, 5 gal. drums and 30, 15 and 5 gal. crocks. Linings complete with double rim, double bottom, cover and maintenance kit. For prices and further information write to the above address.

Business Items

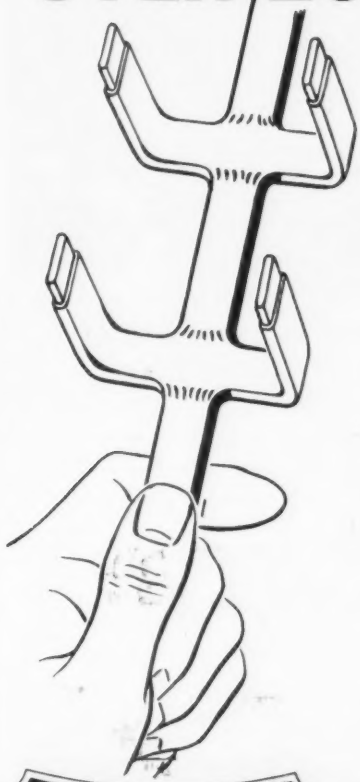
Norton Promoted to Sales Mgr. at H-VW-M

Robert M. Norton

Announcement is made by the *Hanson-Van Winkle-Munning Co.*, of Matawan, N. J., of the promotion of *Robert M. Norton*, until recently assistant sales manager, to the post of sales manager, as of June 20, 1950. Mr. Norton had been assistant sales manager since 1948, after eight years as field representative in New England and New York.

His responsibilities as sales manager will be to continue to direct the sale of electroplating and polishing supplies, and in addition to assist *John A. Bauer*, Vice-President, with general administrative problems.

COATING SURVIVES OVER 2500 CYCLES!



UNICHROME COATING 218X *again proves that it minimizes rack upkeep*

At a Michigan plating plant, Unichrome Coating 218X is considered to be "the best rack coating ever used." For good reason. Racks protected with this green plastisol coating have been working 16 cycles daily for 8 months — and the coatings are *still* in good condition!

Such service is not unusual for Coating 218X. It's one of the toughest materials — physically and chemically — that can be put on racks. It stands up in all plating baths, all cleaners — even vapor degreasers. Coating 218X is approved for leading bright nickels. Applicable in flexible coatings up to 3/16" thick, it won't tear or chip. And with but a *single* prime coat of Unichrome Primer 219PX used, you assure not only better adhesion, but savings in application time as well.

A United Chromium engineer is always ready to show you how to apply Coating 218X for top results. Or if you have no baking facilities, we'll gladly send you names of nearby qualified applicators who can apply it for you. Either way, you stand to gain substantial savings in rack maintenance. Send for data.

UNICHROME Trade Mark **COATINGS for METALS**

Metallic ..... Organic ..... Decorative ..... Protective

Products of UNITED CHROMIUM, INCORPORATED

100 East 42nd St., New York 17, N. Y. • Detroit 20, Mich. • Waterbury 90, Conn. • Chicago 4, Ill.
Los Angeles 13, Calif. • In Canada: United Chromium Limited, Toronto, Ont.

New Corporate Name for Manufacturer of Beckman Instruments

National Technical Laboratories, manufacturers of the well-known Beckman pH Meters, Spectrophotometers, Automatic Titrators and other scientific and industrial instruments, has announced that it has changed its corporate name to "*Beckman Instruments, Inc.*" This action was taken for the purpose of associating the corporate name more closely with the trademark of its principal products.

In the early years of National Technical Laboratories the manufacture of Beckman Instruments was only one of several activities in which the company was engaged. In recent years the demand for Beckman Instruments in scientific laboratories and in modern industrial control operations has grown so large that the development and manufacture of these instruments has become the major interest of the company. The change in name is a recognition of the prominent position which Beckman Instruments have attained in science and industry.

No other changes are involved — either in company organization, policies, personnel, or products . . . or in the locations of its factory and service branches in New York, Chicago and South Pasadena, California. The change in name is made simply for the purpose of more closely identifying the company as the developer and manufacturer of Beckman Instruments and accessory equipment.

Schaffner Expands Their Buffing Composition Manufacture

Schaffner Mfg. Co., Inc., Schaffner Bldg., Pittsburgh 2, Penna., manufacturers of buffing compositions, have just completed a new expansion in plant facilities, warehousing space, and production equipment, due to the constant increase in demand for their compositions. This addition to their new modern plant will enable them to increase their productive approximately, 75%.

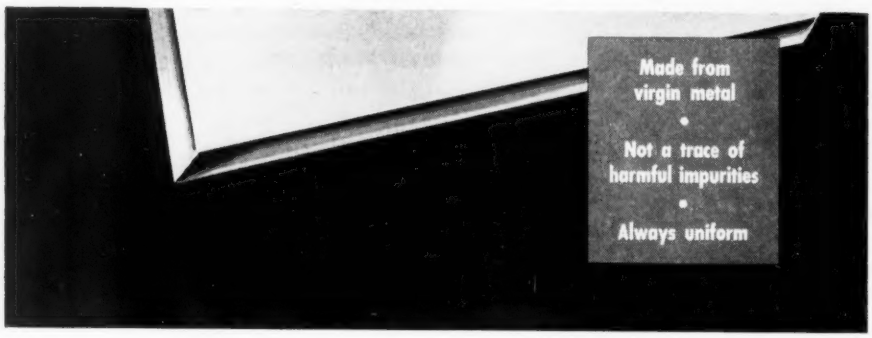
As of September 1st, in addition to manufacturing their own buffing and polishing compounds, they are also adding a platers' supply division. Manufacturers seeking representation or warehouse facilities in the Tri-State area are solicited. The Tri-State area

The mark that means - - LOW-COST
PRODUCTION OF TOP QUALITY *Silver Plating*

It's the mark you find on every Handy & Harman Silver Anode. To silver platers both in the Arts and in Industry, it means *profitable* plating because it identifies anodes free of all impurities that can cause plating troubles—anodes that conform to the highest standards in fineness and physical properties.

For uninterrupted production of highest quality plating look for the 999 "PLUS" FINE mark on the Silver Anodes you use.

HANDY & HARMAN
82 FULTON STREET NEW YORK 7, N. Y.
Bridgeport, Conn. · Chicago, Ill. · Los Angeles, Cal. · Providence, R. I. · Toronto, Canada
Agents in Principal Cities



consists of Western Penna., West Virginia and Eastern Ohio.

Kirk & Blum Buy New Plant

The *Kirk & Blum Mfg. Co.*, Cincinnati, one of the nation's leading dust and fume control manufacturers, recently acquired the entire plant and property of The Cincinnati Planer Co. The plant, located at 3120 Forrer St., in suburban Oakley, will be occupied by Kirk & Blum about the end of the year.

Eight acres of ground surround the facilities, which include over 100,000 square feet of one story manufacturing and storage space, all under one roof, fronted by a two-story, air-conditioned office and engineering building. The plant is completely equipped with bridge and jib cranes and is served by its own railway spur and arterial highways.

The acquired acreage will allow considerable expansion when necessary. Kirk & Blum's five warehousing and manufacturing facilities, now scattered throughout Cincinnati, will be consolidated in the Oakley plant.

Kirk & Blum, founded in 1907 by *Sylvester W. Kirk* and *Richard J. Blum*, specializes in design, fabrication and installation of dust collecting systems, fume control systems and industrial drying and baking ovens.

Richey New Detrex Personnel Manager

Phil H. Richey has been appointed Personnel Director of *Detrex Corp.*, Detroit 32, Michigan, manufacturers of industrial cleaning processes, dry-cleaning machinery, bakery silicone removal systems, and cleaning and rustproofing chemicals.

Sixt Named Technical Assistant at Michigan Abrasive

N. G. Sixt, of Niagara Falls, N. Y. has been named Technical Assistant to *Fred P. Hauck*, vice-president of the *Michigan Abrasive Co.*, it was announced today by *Max C. Jones*, president. Mr. Sixt is a former Carborundum process engineer.

A Major in the Chemical Corps of the U. S. Army Reserves, Mr. Sixt was chief chemist for McLaurin-Jones Co. in Brookfield, Mass., and General Manager of Susquehanna Chemical Corp, New York, before going to Carborundum. He received his degree in chemical engineering from Rensselaer Polytechnic Institute at Troy, New York.

He will be directly responsible to vice-president Hauck in setting up Michigan Abrasive Company's demand for coated abrasives in the automotive and steel industries. Mr. Sixt is a member of the American Chemical Society, the American Institute of Chemical Engineers, and the Technical Association of the Pulp and Paper Industry, also the American Association of Textile Colorists and Chemists.

Miner and Barclay Elected to E. F. Houghton Board

E. F. Houghton & Co., of Philadelphia, announces the election of two

new members to the Board of Directors.

The newly named members are *D. C. Miner*, advertising manager who joined the firm in 1934, and *William K. Barclay, Jr.*, Philadelphia resident partner of Stein Bros & Boyce.

Mr. Miner is also president of Exhibitors Advisory Council, director of National Industrial Advertising Association and past president and director of Eastern Industrial Advertisers, Philadelphia Chapter of the N.I.A.A.

Mr. Barclay is past president and now member of the board of the Executive Committee and Finance Committee of the Philadelphia-Baltimore Stock Exchange. He is past Chairman of the Board, Treasurer and member of the board of the National Association of Security Dealers, Inc., and also past president and member of the board of the Bond Club of Philadelphia.

Both of the new board members served in World War I. Mr. Miner was a Lieutenant in the 50th Infantry while Mr. Barclay was a Lieutenant J.G. in the Navy. Both graduated from the University of Pennsylvania.

Henry Levine & Son Moves Office and Laboratory

After August 15th the Forest Hills office and laboratory of *Henry Levine & Son, Inc.*, consultants on electroplating, will be moved to the Jackson Building, 153 East 26th St., New York, telephone Murray Hill 5-9427.

This expansion and relocation of their laboratories will enable them to offer a more complete service to the metal finishing industry, according to *Mr. Jesse Levine*, head of the firm.

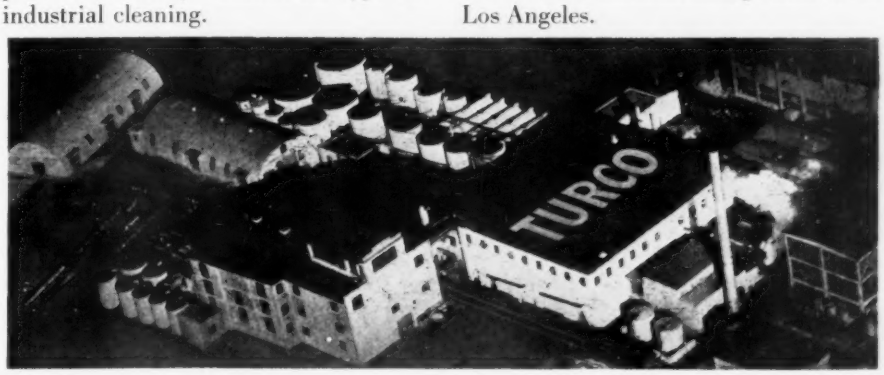
Turco Acquires New Jersey Plant

The acquisition of a large eastern plant as a major step in a continuing expansion program was announced by *Turco Products, Inc.*, leading manufacturer of industrial cleaning compounds. The new facilities, located at 120 Lister Ave., Newark, N. J., will serve as a manufacturing and laboratory center for Turco's Atlantic Division.

Present manufacturing maximums will be approximately doubled by the six major buildings covering 58,000 square feet and by the 950,000-gallon storage capacity of the new three-acre site. Ideally located adjacent to the Pulaski Skyway and the main line of the Pennsylvania, the new factory has an in-the-plant spur line connecting to all major rail facilities, as well as complete dock and lighterage facilities on the Passaic River.

A group of key executives is already at the scene, engaged in working out the details to have the factory in production by September 1, to manufacture Turco's complete line of compounds for every conceivable type of industrial cleaning.

According to *F. E. Warnes*, Sales Promotion Manager, this expansion is the second in a planned series of three, the first being the activation of a liquid manufacturing plant at McCook, Ill., last year and the third being construction of a large west coast factory on a recently acquired ten-acre site in the central manufacturing district of Los Angeles.



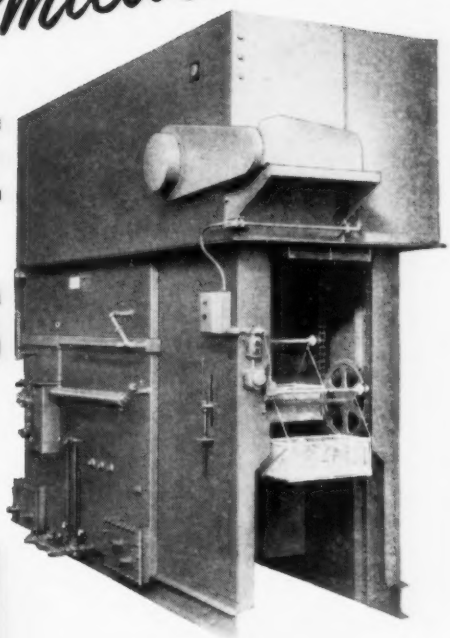
Economical

BLAKESLEE

SOLVENT VAPOR

DEGREASERS

USE LESS SOLVENT



BLACOSOLV

Stabilized Degreasing Solvent — one price, one solvent *for all metals*

NIAGARA

Metal Parts Washers for use with cleaning compounds on either batch or production jobs.

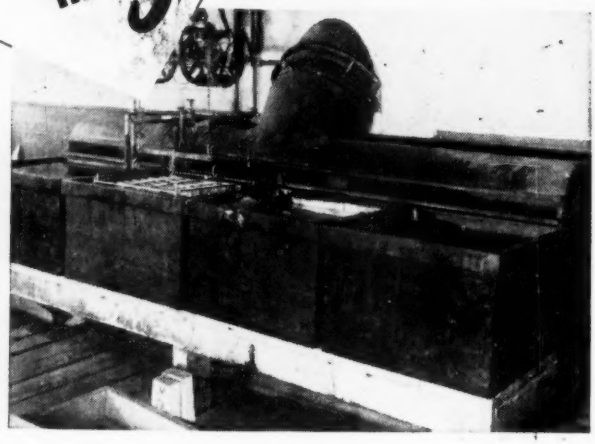
Blakeslee Solvent Vapor Degreasers USE LESS SOLVENT because of the patented construction and operational features. Metal parts are made chemically clean and dry in just a few seconds. Save time, labor, rejects with a Blakeslee Solvent Vapor Degreaser. A Blakeslee engineer-trained representative is available to solve your specific degreasing problems.

G. S. BLAKESLEE & CO.

1844 S. 52nd Avenue • Chicago 50, Illinois

New York, N. Y. Toronto, Ont.

to the one plant in 3 troubled by corrosion DURING METAL FINISHING...



Only HAVEG offers you this practical plan to *permanently* control corrosion of metal finishing equipment:

1. Personal cooperation in the engineering and installation of Haveg equipment.
2. Manufacturing facilities to "tailor-*mold*" Haveg equipment to fit your jobs.
3. Permanent control of corrosion because HAVEG material is resistant to chemicals *all the way through*, not just on the surface.

Thousands of successful installations already made. Many standard shapes available immediately—including tanks, piping, fittings, valves, etc. Quick service on tailor-made shapes. Get more information—no obligation. Send for new Bulletin F-6.

HAVEG CORPORATION
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FACTORY: MARSHALLTON, DEL. · TEL. WILMINGTON 3-8884

CHICAGO 11	CLEVELAND 14	HARTFORD	HOUSTON 6	DETROIT 11	LOS ANGELES 13	SEATTLE 1
1201 Palmolive Bldg.	550 Leader Bldg.	57 Farmington Ave.	4601 Montrose Blvd.	2832 E. Grand Blvd.	601 W. Fifth St.	Vance Bldg.
Delaware 7-6266	Cherry 7297	Hartford 64250	Jackson 2-6065	Madison 1575	Mutual 8955	Eliot 0890

Nickel on Voluntary Rationing Plan

The International Nickel Co. recently instituted a system of voluntary rationing of nickel metal to its customers. The action was brought about by the unprecedented demand for nickel, principally from the steel industry, which has been operating at 100% capacity for the past few months. Increased Government stockpiling may also be contributing to the need for rationing, although this has not been confirmed by government sources. The present demand for nickel is more than double the pre-war rate, and 25% higher than the best post-war year of 1948. The demand now exceeds the production capacity.

This action follows a recently announced price increase of 8 cents per pound for pure nickel. This voluntary rationing program is not expected to affect the amount of nickel available for electroplating to any great extent.

Bordeau New Cleveland Manager for American Buff

Robert J. Bordeau has been appointed District Manager for *American Buff Co.* and the *Automatic Buff Co. Div.*, both of Chicago, for Cleveland and the Northern Ohio territory. Mr. Bordeau will headquarter in Cleveland

Robert J. Bordeau

with offices at the Leader Building, and his personal services will be available to the sizeable buffing industry in that area.

Bob Bordeau comes to the buff industry with many years of varied experience, ranging from advertising agency work to servicing and selling. He recently represented W. R. Brown Corporation, Craftint Manufacturing Co., White Aircraft Corporation, Super Manufacturing Corp., Red Band Products, and other manufacturers of industrial finishes.

Kraft Chemical Co. Representative for Chromic Acid

Kraft Chemical Company, 917 West 18th St., Chicago 8, Ill., regrets that a previous item appearing in these pages gave the impression that Kraft was now stocking paints and plastics for The Better Finishes & Coatings, Inc. This is not the case, since Kraft represents Better Finishes & Coatings only for the distribution of High Quality Plating Grade Chromic Acid Flake.

Conde New Sales Promotion Manager for Brady-Milwaukee

The *Brady-Milwaukee Div.* of *W. H. Brady Co.*, Chippewa Falls, Wis., manufacturers of Quik-Label Wire, Pipe & Conduit Markers and Die-Cut Masks, announce the appointment of *John P. Conde* as Advertising and

Chalfant to Represent Optimus in New Jersey

The *Optimus Detergents Co.*, of Matawan, N. J., announces the appointment of *Charles N. Chalfant* as Industrial Service Representative in

Charles N. Chalfant

the metropolitan New Jersey area.

Mr. Chalfant brings to Optimus four years of intensive experience with the Wyandotte Chemical Co., in sales and service engineering among industrial users in the southwestern Ohio territory. Prior to that, he was Detroit service representative of G. Whitfield Richards, manufacturer of cutting, drawing, and grinding lubricants. His previous industrial experience had been as a member of the chemical and metallurgical laboratory staff of the Copperweld Steel Company. His background in chemical and metallurgical studies was at Carnegie Tech. and the University of Pittsburgh.

Dittbrenner to Represent Carboline in The East

The Carboline Co., of St. Louis Mo., announces the appointment of *R. A. Dittbrenner* as their Eastern Representative. Mr. Dittbrenner has been employed in corrosion work for the past 17 years.

In addition to being their Eastern Representative, Mr. Dittbrenner will handle the Advertising and Sales Promotion for Carboline on their line of thermosetting and thermoplastic coatings and linings for erosion and corrosion service.

British Production Team to Study U. S. Metal Finishing Methods

Dr. G. E. Gardam and *Mr. R. A. F. Hammond*, two of Britain's outstanding electroplating experts, are expecting to visit the United States as members of an Anglo-American Productivity Team which will arrive in America towards the end of August. The team is to study metal finishing, with the object of finding out what features of American methods might usefully be adopted in England to improve productivity.

REGENERATION
of
CHROMIC ACID
SOLUTIONS
by
CATION EXCHANGE

Mutual's

ANSWER TO THE CHROMIC ACID WASTE DISPOSAL PROBLEM . . . .

Where spent chromic acid solutions containing dissolved metals pose waste disposal problems, the ideal answer — elimination of the waste and regeneration of the chromic acid solutions for re-use — may be realized by employing oxidation resistant cationic exchange resins. Research chemists at Mutual Chemical Company of America have recently completed a preliminary investigation of the applicability of this technique to anodizing, copper stripping, brass pickling and chromium plating baths. Utilization of this principle appears feasible for other metal treatments employing chromic acid—with marked savings in processing costs.

Write today for a copy of "Regeneration of Chromic Acid Solutions by Cation Exchange" Mutual's Serial No. 65.

SINCE 1845

MUTUAL CHEMICAL CO. OF AMERICA

270 Madison Avenue New York 16, N. Y.

Manufacturers' Literature

Chromium Chemicals

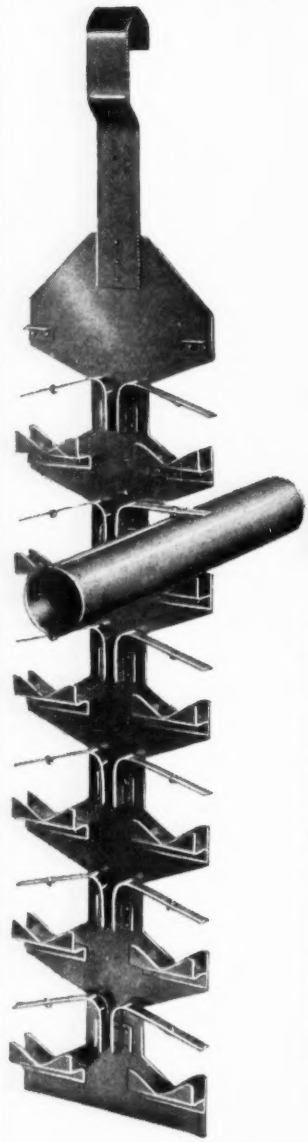
Mutual Chemical Co. of America, Dept. MF, 270 Madison Ave., N. Y. 16, N. Y.

This firm has just issued a new booklet on various chromium chemicals, giving their history, properties, and uses. Many charts are included on grades and packing, density of solutions, freezing points of solutions, solubility, viscosity, pH, specific heat of solutions, and many other technical properties. The booklet is designed to meet the needs of chemists and engineers working with these important chromium chemicals. For a free copy write to the above address.

Salt Spray and Humidity Test Cabinets

Industrial Filter & Pump Mfg. Co., Dept. MF, 5900 Ogden Ave., Chicago 50, Ill.

This firm has issued a revised catalog page on their test cabinets that are used for accelerated testing of the corrosion-resisting qualities of coatings on metal products. These cabinets are used extensively by manufacturers and users of paints and lacquers, and in electroplating plants. This new literature gives detailed description of ap-



NEW!

Anodizing Rack Insulation

PASTE

Single Coat Primer
One
Top Coat Baked

AIR DRY

No Baking
All
Tough Air Dry

BUNATOL

special insulation for aluminum anodizing racks and fixtures. Unusual adhesion to metallic aluminum and made to withstand the strongly acid anodizing solutions. Makes rack insulation a profitable investment because racks will last so much longer with repair costs greatly reduced.

BUNATOL No. 796 is a new air-drying insulation for aluminum which, with a few coats, will give complete insulation coverage and protection. Thick liquid can be used by brushing or dipping. Permanently flexible with extra adhesion to stop seepage. Very tough to withstand cuts and abrasion. Synthetic resin base gives unsurpassed chemical resistance. No equipment necessary. Just clean the rack, apply a few coats and air dry.

Where a baking oven is available the use of the special Aluminum Primer and **BUNATOL Paste No. 1002** will save time and labor. Just apply a single coat of No. X126 Primer and bake, and quickly dip a single coat of the Paste and bake; the entire operation in about two hours. The high gloss Paste is very thick and flexible and of extreme toughness to stand wear and shop abuse. Excellent chemical resistance. Designed to protect aluminum racks at very low over-all cost. No. 1002 Paste insulation will often last as long as the rack. Save time and cost by insulating anodizing racks with **BUNATOL**. Get the facts — just write

Nelson J. Quinn Company
Toledo 7, Ohio

plications, design features, and the principal specifications of the different size models.

Corrosion Engineers Manual

Nukem Products Corp., Dept. MF, 111 Colgate, Buffalo 20, N. Y.

This 36-page manual just issued by the above firm gives information on corrosion resistant materials such as cements, linings, floors, and sewers. The various types of cements and coatings are described and their corrosion resistant properties tabulated. Engineering data on shapes available in bricks, shipping data on cements, estimating requirements, and acid-proof tank construction is all included. Write for your copy to the above address.

Custom Built Electrical Power Equipment

The Electric Products Co., Dept. MF, 1725 Clarkstone Rd., Cleveland 12, O.

A new bulletin issued by this firm pictures and describes their line of electrical power equipment, which includes AC and DC motors, AC and DC generators, electroplating motor generators, frequency changers, battery chargers, and other electrolytic power supplies. Copies of bulletin 2-200 are avialable on request.

Bright Dip for Zinc

The Chemical Corp., Dept. MF, 54 Waltham St., Springfield 9, Mass.

This firm has issued a bulletin on their Luster-On Utility-15 bright dip for zinc plated articles. This bulletin gives operating details, bath maintenance information, prices, and outlines the advantages of using this low-cost treatment for imparting a lustrous and corrosion resistant finish on zinc plated parts. Copies are available on request.

Water Dispersable Buffing Compounds

Globe Compound Co., Dept. MF, Waterbury, Conn.

A new folder being distributed by this firm describes the advantages of their water dispersable compositions for buffing and coloring. A complete line of compositions are available, including rouges, tripoli, white finishes, steel cutting compounds, and many special compositions for exacting work of special nature. The firm is prepared to furnish samples of their materials for trial in your own plant on request.

Corrosion-Resistant Linings & Coatings

Atlas Mineral Products, Dept. MF, 42 Walnut St., Mertztown, Pa.

The above firm announces the publication of their new General Bulletin MCC No. 1. This bulletin briefly describes Atlas' complete line of chemical construction materials, including corrosion-proof linings, corrosion-proof cements, acid-proof brick and tile, corrosion-proof brick sheathings, corrosion-proof protective coatings and corrosion-proof floors. It also includes handy estimating data. Write for your copy.

Corrosion Resistant Paints

U. S. Stoneware Co., Dept. MF, P.O. Box 350, Akron 9, O.

This firm has just released a new bulletin on their Tygon corrosion-resistant paints. The facts about Tygon paint are presented in this authoritative booklet in a completely honest manner; it tells where and how to use Tygon paint, and where not to use it.

The corrosion resistant tables, based almost entirely on field experience, are unique in their completeness. Ask for Bulletin 712.

Copper Oxide Rectifiers

General Electric Co., Dept. MF, Apparatus Dept., Schenectady, N. Y.

This firm has issued a new price

list effective Aug. 14, 1950 on its line of copper-oxide plating and anodizing rectifiers. Prices for 6 v.-40 amp. size up to 6 v.-40,000 amp. size are given. Anodizing rectifiers of 24-48 v.-500 amp. and barrel plating rectifiers of 9 v.-1,250 amp. are also included. Copies of this price list are available on request.

Plating Anodes

Federated Metals Div., American Smelting and Refining Co., Dept. MF, 120 Broadway, New York 5, N. Y.

This firm, a leading marketer of non-ferrous products, has released a handsome 12-page booklet on anodes for the plating trade. Regular anode products of Federated include M-Sterling chill-formed copper anodes, electro-deposited copper anodes, lead anodes, and those of zinc, tin, brass and cadmium.

The new Federated catalog on Anodes is refreshing for its virtually complete lack of "selling talk" and its concentration on the facts that the man in the plating business needs to know. Anodes are listed in full detail as to size of body, length of hooks, and other essential data. Excellent drawings illustrate the shape and dimensions of the various forms in which anodes are available.

Free copies of the new booklet may be secured on request.

Wet and Dry Tumbling Processes

Lupomatic Industries, Inc., Dept. MF, 4510 Bullard Ave., New York 70, N. Y.

This firm has issued a new bulletin covering Tumb-L-Matic processes, compounds, and carriers.

The bulletin describes basic steps for completely finishing metal and plastic parts by wet and dry tumbling processes. All operations are automatic, and in most cases result in a high lustrous finish without resort to costly polishing and buffiing operations, it is claimed. The effects of each of the three most widely-used Tumb-L-Matic operations — cutting, smoothing, and lustering — are discussed fully.

The bulletin also contains general information on the proper use of various compounds and carriers. Four charts indicate specifically which Tumb-L-Matic compound-carrier combination should be used for the different operations conducted in both the wet and dry processes. These charts apply to the majority of finishing jobs.

For a copy of the informative bulletin PC-50, write directly to the above address.

for { *Tough Buffing..*
Mirror Finish...
Easy Cleaning....

SPEEDIE Stainless Steel and Chrome Compositions

Fill the Bill *Every* Time!

ARE YOU getting stainless steel that's rough and tough to buff? Is it hard to remove knicks and scratches . . . and difficult to produce a mirror finish? Then you need SPEEDIE Stainless Steel Compositions.

No. 471 is without a peer for cleaning a dirty piece of stainless steel. It *colors* as well as *cuts* so you do *two* operations at the same time.

No. 471 SPEEDIE Stainless Steel Composition is 100% saponifiable so your work is easily cleaned.

Performing equally as well are the famous SPEEDIE Chrome Compositions which color your work excellently, and are especially recommended for removing burnt chrome marks. They are also 100% saponifiable so you save money in your cleaning operations.

Write today for illustrated catalog on SPEEDIE Buffing Compositions and Polishing Room Accessories.

Polishing Room Supplies and Equipment

BP THE BUCKEYE PRODUCTS CO.
7033 Vine Street Cincinnati 16, Ohio
Cable address: Buckprod

Electrolytic Cleaning

The DuBois Co., Industrial Div., Dept. MF, Cincinnati 3, O.

A new booklet just issued by this firm contains useful information on electrolytic cleaning processes, explains simply the phenomena taking place during both direct and reverse current electrocleaning, and lists the relative advantages of each method. Also are included the properties required of a good electrocleaner. A few typical cycles are also given for their new electrocleaner Alkon.

Platers Cleaner

Detrex Corporation, Dept. MF, Box 501, Detroit 32, Michigan.

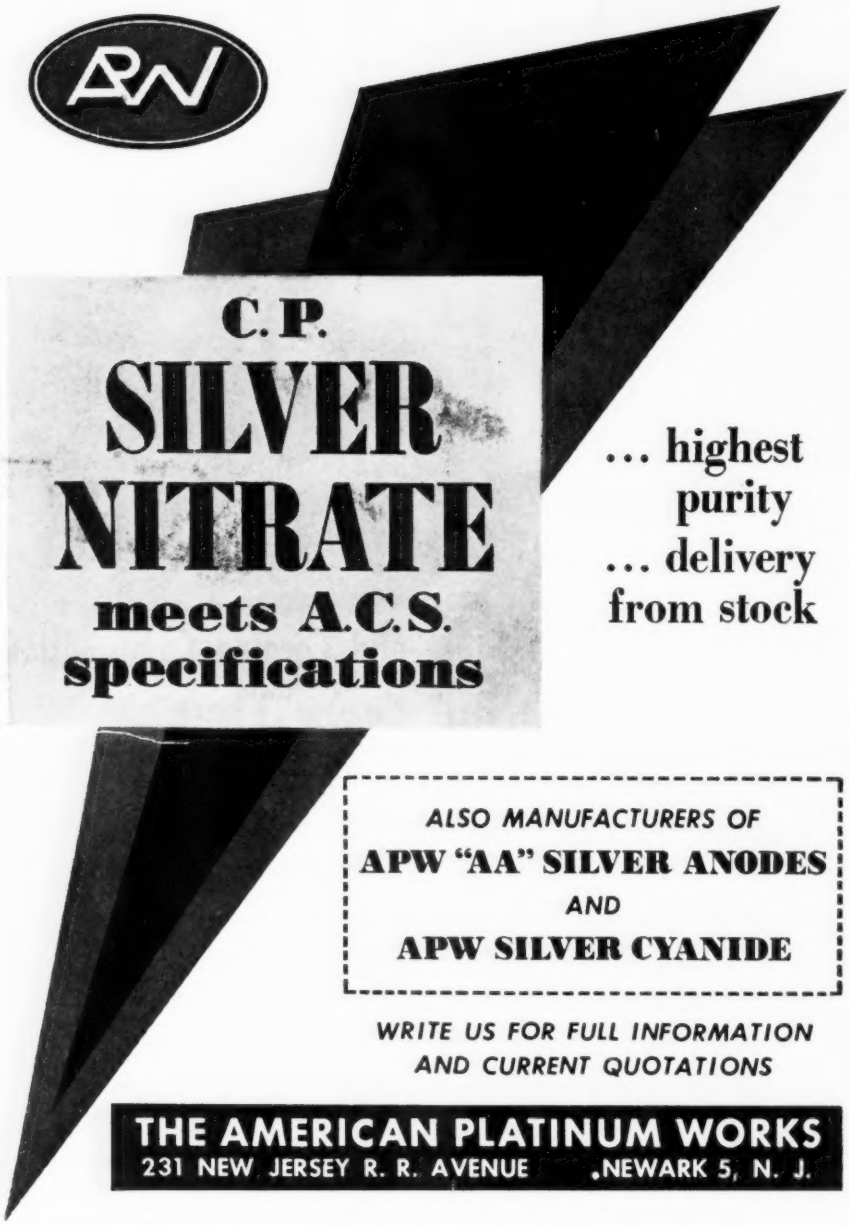
An electrolytic cleaner compounded especially for use on steel, brass, nickel, and die castings, is described and illustrated in a folder being distributed by the above company.

Lead Anodes

Republic Lead Equipment Co., Dept. MF, 7930 Jones Rd., Cleveland, O.

This firm has just released a new bulletin on their homogeneous lead anodes for chrome plating.

Only the Republic anode has the



copper hook homogeneously burned to the anode. The bond formed by the Republic Lead process is said to be so tight that the lead actually contracts with the copper assuring a positive electrical contact for the entire life of the anode.

Copies of the bulletin are available on request.

Management of Industrial Research

Pub. by Arthur D. Little Co., Cambridge 42, Mass. Free.

This firm makes available without charge a 20-page brochure containing an extensive annoted bibliography of references in the field of industrial research management. Books, periodicals, and other references are cited, and the total list contains 96 references. A subject index is also included.

Corrosion Resistant Cements

Carboline Co., Dept. MF, 7603 Forsyth Blvd., St. Louis 5, Mo.

Bulletin C-8 is a two-page bulletin describing the use of corrosion resisting cements to repair cracked, corroded and broken pipe, pumps, valves and other mechanical equipment in corrosive service. Equipment which can be repaired can be made of steel, iron (and other metals), hard rubber, glass, porcelain, carbon, stoneware, wood or plastic.

The synthetic resin cements used are resistant to practically all acids, solvents and alkalis, up to temperatures of 325°F., it is claimed. The only common acids which cannot be handled by these repair cements are sulfuric acid above 90% concentration, and nitric and chromic acids. When set, the repair cements are hard, resistant to abrasion and can be machined if necessary.

Water Deionization

Resinous Products Div., Rohm & Haas Co., Dept. MF, Washington Square, Philadelphia 5, Pa.

A new 12-page illustrated booklet on "Amberlite Monobed Deionization" offers a miniature textbook in readable form on the history, behavior, present performance and potential uses of the Monobed ion exchange systems in the water-conditioning, chemical process and other industries.

Reactions of the various combinations of exchangers are explained in text and equations. The 8½ x 11-inch booklet discusses operating costs, equipment costs, quality of product derived, rinse requirements and other properties as they apply to the complete or partial single-step removal of ionized solids from solution. A three-page section is devoted to design and operation of Monobed equipment, and more than 80 fields of possible applications are listed. A final table shows helpfully the nomenclature, chemical behavior and typical uses of each of the six systems thus far developed and evaluated. The booklet is available free on request.

Recording Thermometers

The Bristol Company, Dept. MF, Waterbury 20, Conn.

This firm has just published a 44-page bulletin giving complete information on its Series 500 line of thermometers. Liquid-filled, vapor pressure, and gas-filled types are described in models for recording, indicating, controlling, and telemetering of temperatures. Each of the types of thermometers is fully described with information given on operating principles, characteristics of operation, temperature sensitive bulbs, recording charts, and accessories. Resistance type thermometers, humidity instruments, and time-temperature controllers are also described. In addition to numerous photographs, this free bulletin is liberally illustrated with reproductions of actual temperature char

records and sketches of applications to enhance its value as a handbook of industrial thermometry.

Black Beauty Blasting Abrasive

American Wheelabrator and Equipment Corp., Dept. MF, 752 South Byrkit St., Mishawaka, Ind.

A 4-page bulletin on Black Beauty, the non-metallic, silica-free, blast grit is now available from this firm.

This is a sharp, fast-cutting abrasive that retains its abrading qualities even when reduced to very fine material, according to the firm. Although it has much the same properties as sand, there is no free silica to create an occupational hazard. It wears 2 to 5 times longer than sand, is less damaging to equipment, is non-corrosive, stainless, rustless, flows freely, will not attract moisture, and does not pack or harden, it is claimed.

Black Beauty is supplied in a variety of sizes graded for any type of work or finish desired. Shipment from stock can be made immediately.

A copy of this bulletin may be obtained free by writing to the above address.

NEW BOOKS

Determination of Impurities in Plating Solutions—Part XV-XIX Silver, Chloride, Lead, Chromium and Nickel in Copper Plating Baths

By E. J. Serfass, P. Burkhead, W. S. Levine, P. J. Prang, M. H. Perry, S. Sen, and R. B. Freeman. Published by American Electroplaters Society, P. O. Box 168, Jenkintown, Pa. Price $1.00.

Gives analytical methods for the detection and estimation of traces of these metals in copper plating baths. This work is carried out under the sponsorship of the Research Committee of the A.E.S.

Text Book of Gilding

Pub. by Wagner School, 470 Stuart St., Boston, Mass. 115 pages, 5½" x 8½", $3.00, postpaid.

Text Book for Gilding was written as a practical guide for instruction in decorating various types of surfaces such as glass, wood, plastics, metals, etc.

Considerable detail has been covered by the author as to the various types of materials and the metal foils used for forming the so-called gilding films on the given surface, with a view towards appealing to the practical worker as well as the hobbyist.

Mr. Wagner should be complimented on so fine a text, for the way it is presented, and for the many illustrations to emphasize the points used by the author in describing both the materials and the methods.

Samuel Wein.

Electroplating

By A. H. Sanders. Published by International Textbook Co., Scranton, Pa. Price $2.75. 5½" x 8". 115 pages.

This book is intended to be an introduction to the electroplating field for students and beginners, as well as hobbyists. Discusses plating principles, gives bath formulas and operating details for commonly plated metals, preparation for plating, setting up equipment, power supplies, etc. About 25% of the text is devoted to principles and theory necessary to an understanding of the operations described in the balance of the text. Numerous photographs illustrate the commercial equipment used. Of special interest to hobbyists will be the section on the preparation of baby shoes for metallizing and plating. While the experienced plater will find very little new information in this book, and although certain subjects of great practical importance are covered rather lightly, this book fills its intended purpose of being a good starting text in the plating field.

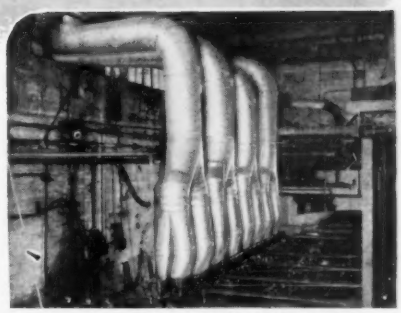
W.A.R.

Ohio FUME AND DUST REMOVAL SYSTEMS
TANGIBLE DOLLAR SAVERS

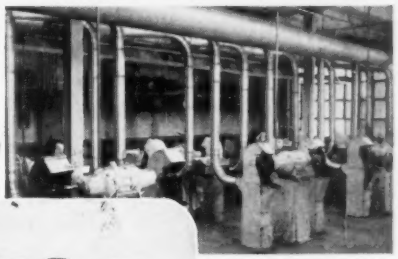
● Records on hundreds of Ohio Blow Pipe jobs prove without question that production output materially increased and employee absence and complaints radically decreased after the installation of an Ohio System for ventilation of fumes from plating and rinse tanks and dust collection from grinding, polishing and buffing.

Ohio Systems are not standard fit-all systems. They are designed and engineered to meet your individual requirements. Ohio engineers, thoroughly experienced in their field, make a careful, exacting survey of your plant and an analysis of conditions and then plan the system that will meet most efficiently your special needs and conditions.

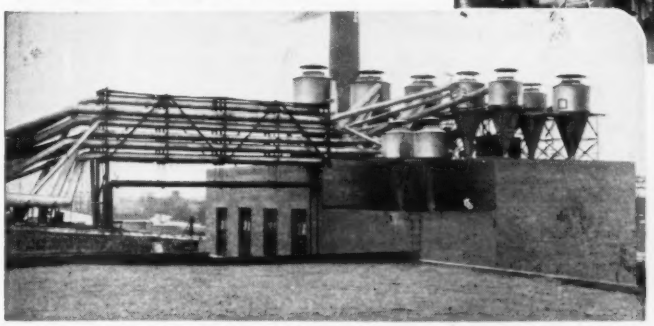
Call, write or phone today and let Ohio engineers make a survey and give you, without obligation, an estimate.



Fumes Removal Installation in Plating Room



Dust Collecting System for Buffing Machines



Cyclone Type Dust Collectors

Write today for free illustrated color folder showing you how an "Ohio" system protects your profits.

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GOLD & RHODIUM

GOLD and RHODIUM
PLATING SOLUTIONS
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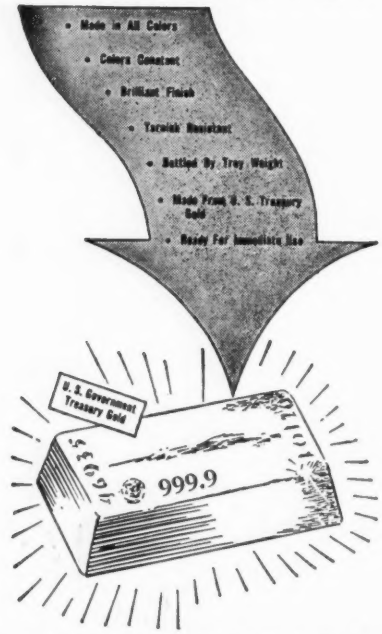

SOLUTIONS

DAVIS-K—makers of GOLD PLATING SOLUTIONS—prepared in all colors that produce hard, tarnish-resistant, color constant deposits.

Compounded from U. S. Treasury GOLD and highest (C.P.) chemicals. Sold by troy weight—certified 100% gold content.

Solutions are simple to operate and maintain.

ANTIQUE SOLUTIONS—Deposit gold and antique in one operation—produce uniform finish—simple to operate. Your samples plated at no charge.

We welcome inquiries pertaining to precious metal plating problems. Distributors of Bakers' lustrous RHODIUM SOLUTIONS, that produce a long-lasting white finish.

"Where glittering elegance reflects lasting quality"

DAVIS-K PRODUCTS CO.

54 West 22nd Street ORegon 5-0094-5 New York 10, N. Y.

NEWARK BRANCH OPEN HOUSE

Friday, Sept. 15, 1950 — 8:00 P.M.

Robert Treat Hotel, Newark, N. J.

The Newark Branch of the AMERICAN ELECTROPLATERS' SOCIETY cordially invites all those who are interested in plating and metal finishing to "Get Acquainted" with the Society, its members, and its endeavor to disseminate information on electroplating in all its aspects.

Among the features to be presented are a short discussion on the Society and items of interest to platers and a Question and Answer session. Refreshments will be served.

Transactions of The Electrochemical Society—Vol. 93

Published by the Electrochemical Society, 235 W. 102 St., N. Y. C.

Contains the minutes of the annual meeting and general society business and news, as well as the following technical papers and discussions:

A Study of Films Isolated from Passive Stainless Steels.

Corrosion of Silver in a Water-Saturated Chlorine Atmosphere.

Inhibition of Steel Corrosion by Sodium Nitrite in Water.

Corrosion Characteristics of some Magnesium-Zinc-Calcium Alloys.

Deposition of Lead from Ethylbenzenesulfonate Baths.

Passivity of Chromium.

Chromated Protein Films for Metal Protection.

Mechanism of Nitrite Inhibition of Steel Corrosion.

Electrolytic Thickness Tester for Metallic Coatings.

Electrochemistry of Indium.

Electropotentials in Growing Halide and Oxide Layers on Metals.

Effect of Amines on Electrode Potential of Copper in Buffered Acid Baths.

Deposition of Tantalum and Columbium from their Volatilized Halides.

Dissolution of Aluminum in Sodium Hydroxide Solutions.

Metal Finishing Manual

Published by Iron Age, 100 E. 42 St., N. Y. C.

This volume, a revision of a previous manual, contains the articles previously published in the weekly editions of Iron Age. The list of articles follows.

Metals, Finishes, and Finishing Processes, *by E. Engel.*

Iridite Treatment for Plated Parts.

Wrinkle Finishes — 25 Control Points, *by E. A. Zahn.*

Barrel Polishing of Small Brass Parts, *by T. S. Blair.*

Solderability of Lead—Tin Alloy Plating, *by L. H. Seabright.*

Electropolishing Brass, *by W. G. Axtell.*

Electropolishing Silver, *by D. Gray and S. E. Eaton.*

Electropolishing of Metals, *by H. Pray and C. L. Faust.*

Tinning Cast Iron.

Metal Coatings by High Vacuum Evaporation, *by P. Godley.*

Reducing Embrittlement in Plating, *by C. T. Eakin* and *H. W. Lownie.*

Effect of Lead in Galvanizing Baths, *by W. Imhoff.*

Specifying Rust Preventatives, *by J. Albin.*

Production Line Rustproofing, *by A. D. Stout.*

Performance and Structure of Anodic Coatings on Aluminum, *by F. Keller* and *J. D. Edwards.*

Finishes for Aluminum, *by J. F. Mason.*

New Surface Treatment for Aluminum, *by J. Anthony.*

Fast Methods for Cleaning Bearings, *by J. Albin.*

Stripping Metal Overlays, *by J. B. Mohler.*

Modern Paint Removers, *by L. E. Kuentzel* and *A. W. Liger.*

Safe Operation of Solvent Degreasers, *by L. P. Litchfield.*

A Periodic Chart for Electroplaters, *by G. Dubpernell.*

Precision Plating of Bearing Alloys, *by R. A. Schaeffer.*

Plating Metals on Non-Metals, *by A. Bregman.*

Common Plating Baths Troubles, *by J. B. Mohler.*

Plating Alloys from Cyanide Baths, *by J. B. Mohler.*

Production Plating of Zinc Die Castings, *by H. Chase.*

Effect of Water on Metal Finishing Operations, *by R. S. Herwig.*

Plating Bath Voltage, *by G. W. Croninger* and *J. B. Mohler.*

Economical Rinse Tank Design, *by J. B. Mohler.*

Buffing Before Plating to Improve Rust Resistance.

Current Zinc Electroplating Practice, *by A. Bregman.*

Specification Plating, *by C. B. F. Young.*

Cadmium Plating, *by A. Bregman.*

Cadmium Plating, *by A. Fusco* and *N. Woldman.*

Plating Recessed Areas with Dipolar Electrodes, *by U. C. Jones.*

Gold and Chrome Combination Plating, *by W. A. Hopkins.*

Plating Waste Disposal, *by J. Bleiweis.*

Coloring of Metals, *by H. R. Simonds* and *C. B. F. Young.*

Heavy Nickel Plating, *by P. Ritzenthaler.*

A Control System for Spray Painting, *by E. A. Zahn.*

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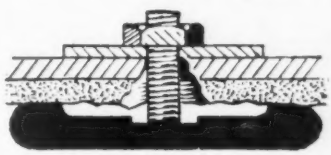

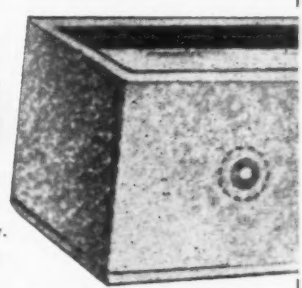

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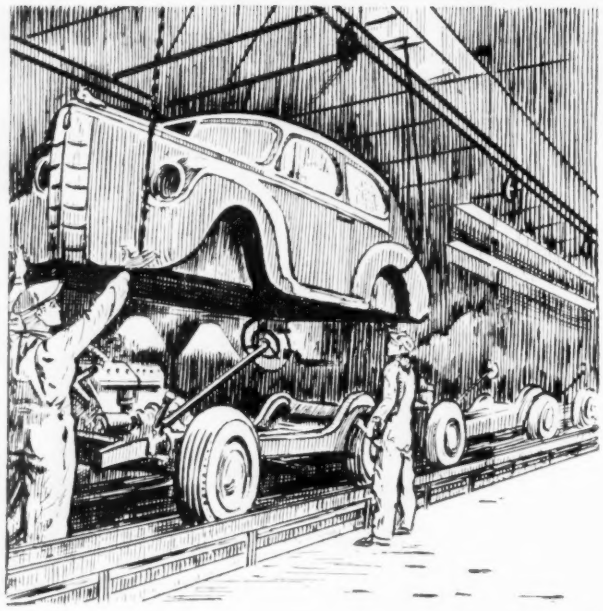

MOTOR CITY PLATING NEWS

by

Edward Finne

Detroit's Annual Stag Day was a remarkable success. The event, held at Forest Lake Country Club on Saturday, July 29th, attracted well over 600 guests throughout the day. This gathering was by far the best attended of the three Stag Days the Detroit Branch has promoted. The weather co-operated —it was beautiful. The steak dinner was excellent; entertainment, athletic events, and refreshments combined to make the day well spent by all in attendance. *Walter Pinner* and *Fred Wagner*, co-chairmen of the event, deserve a big hand for their many days spent in preparation, along with their committee members *Charley Conley* and *Stan Krentel* in charge of sports, *Frank Clifton*, treasurer, *Dick Saltonstall*, responsible for the floor show, *Red Newton*, who handled publicity, and *Cleve Nixon*, ex-officio member.

Many played golf and the prize winners of the Golf Kickers Handicap were *Smith*, *Jewell*, *Willie*, *Marshall*, *Baldwin*, *Shires*, *Brodie*, *McCormick*, *Wiscko*l and *L. Ward*. *Hammond* won

Stutz Creators of the first plating barrel to withstand the complete plating cycle

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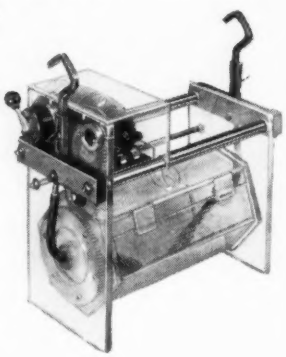

The best looking. The best mechanically. The best in production. The best from any way you look at it. Revolves through the entire plating cycle without transfer of load from one cylinder to another. Made in Two Sizes:

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with reversing switch and plug-in cord and with standard perforations of 3/32″ or larger.

Small perforations extra.

As Lucite is non-absorbent, one unit can be used for all solutions and temperatures not exceeding 185° F.

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Step up your Alkaline Tin Plating

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Because with Potassium Stannate current efficiency does not fall off with higher current densities.

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Specialists in Tin

Television set and plaque awarded to Frank Clifton by the Branch.

Egg throwing contest drew large crowd.

Al Robinson tries his luck at trick golf driving.

Easiest hole on the Course — #19.

the dubious honor for high scoring.

The Bait Casting Contest and Horseshoes were the most popular events. These were patronized all day long. *Rafferty* and *Lilly* won prizes in bait casting and *Higgins, Thorp, White* and *Turkitte* won out in horseshoes. *D. Berry* proved to be best in the Trick Golf Driving Contest, and *Ernie Bechtol* won the prize in Golf Trick Putting.

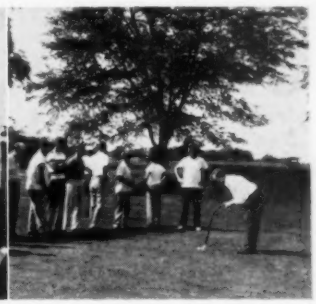
The most hilarious contest was the Pie Eating. Ten brave men entered—*Sanbanket* and *Hoffski* finished in a dead heat. The next messiest was the Egg Throwing Contest, and the *Provost* and *Portman* team won.

Everybody won a door prize. This

Clifton, Neill, Pinner, Nixon, Conley, and Heussner talk it over.

Joe Hoefer eating his blueberry pie.

Winner of pie-eating contest.



Putting with rubber-shafted putter.

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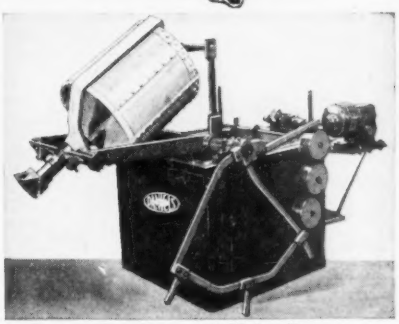

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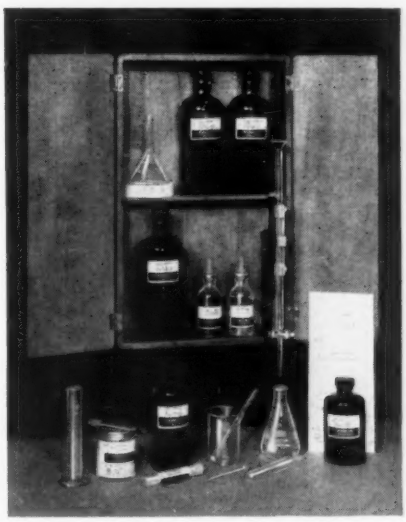

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★ Economical to Use — 4 Gallons Plating Solution from 1-oz. of Gold
★ All Popular Shades — Also Matched Shades
Pre-Plate, Hamiltons — Yellows — Lilacs — Pinks — Greens, etc.
★ Gold Content Unconditionally Guaranteed
★ Why Pay for Shipping Water — Use the Salts

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year everyone drew for his door prize upon coming to the Stag Day—prizes ranged from cigarettes to tools to shirts to golf bag carts. In previous years, conventional drawing for door prizes produced only a few winners.

****

Howard Plating Industries, Royal Oak, has purchased the plant and equipment of Milbrook, Inc., 22840 Sherwood, Van Dyke, and is operating the newly acquired plant as their #2 plant.

****

Cliff Heckenberg, Detroit manager of the *New England Buff Co.*, announces the appointment of *Robert O. Blackford*, 1336 Calvin Ave. SE, Grand Rapids, as sales representative in Grand Rapids and Western Michigan. Mr. Blackford is well known to the metal finishing trade in Michigan having followed the abrasive line for over 15 years in this area. He also represents *Buckingham Products Co.* and the *Michigan Abrasive Co.*

****

Charley Anger has joined Lyon, Inc., 13881 W. Chicago Blvd., Detroit as buffing compound supervisor.

Mr. Don T. Barrett, president of the *Roto-Finish Company*, of Kalamazoo, Mich., has just returned from an extensive tour of a month's duration of the West Coast.

Mr. Barrett commented that he believed Californians were much more conscious of a national emergency existing than either the middle West or the East. This is reflected in the fact that Western Industry is prepared for top production in the event of a full fledged war.

****

Ray Shock, executive secretary of the National Association of Metal Finishers, 2236-39 Dime Bldg., Detroit recently made an extensive tour through the South and Southwest contacting job plating shops. As a result of his trip, the following new local associations were organized:

PLATING ASSOCIATION OF NEW ORLEANS

Long's Plating & Polishing Works, 335 Burgundy St.

Paramount Plating & Metal Finishing Co., 3105 Magazine St.

Zito's Plating & Polishing Works, 621 S. Prieur St.

HOUSTON PLATING ASSOCIATION

Houston Retinning & Plating, 2305 Preston Ave.

National Plating Co., 2523 Wroxton Rd.

Southwestern Plating Co., 1112 Rosine St.

Ware Electroplating Co., 307 Chenevert St.

Bronze Art Casting & Plating Co., 5129 Lawndale.

DALLAS-FT. WORTH PLATING ASSOCIATION

R. & L. Plating Co., 3247 Lovefield Drive, Dallas.

W. M. Teer Plating Co., 2123 Cedar Springs Ave., Dallas.

Therm De Tinning Co., 2009 S. Industrial Blvd., Dallas.

Teer Plating Co., 5013 E. Lancaster, Ft. Worth.

Electro Plating & Mfg. Co., Ltd., 1718 Browder, Dallas.

White Plating & Processing Co., 4036 Commerce, Dallas.

Industrial Plating Co., 2612 Louise St., Dallas.

Ace Plating Works, 2235 Cedar Springs, Dallas.

Advance Plating Co., 507 W. Leuda, Ft. Worth.

American Plating Co., 308 W. Ferrell St., Ft. Worth.

Specialty Plating Co., 2518 N. Haskell, Dallas.

Lane Plating Works, 914 Hall St., Dallas.

KANSAS CITY PLATING INSTITUTE

DeTray Plating Works, Inc., 11th & Hardy, Independence, Mo.

Hiles Plating Co., 1113 McGee St., Kansas City.

East Side Plating Co., Inc., 2641 Jackson.

Missouri Plating Co., 1426 Cherry.

Bar-Rusto Plating Corp., 1808 Locust St.

PLATING ASSOCIATION OF EVANSVILLE, IND.

Quality Plating Works, Inc., 1331 Grove St.

Evansville Plating Works, 100 Indiana.

Miller Electro Plating, Inc., 301 N.W. First St.

Pennsylvania Salt Mfg. Co. opened a new Detroit and Southern Michigan district sales office at 1114 Buhl Bldg., Detroit, discontinuing its Wyandotte sales office.

****

Harry G. Potts, district sales manager of the company's heavy chemicals department, will be in charge of the new office assisted by *W. B. Adams*, heavy chemicals sales representative, and *Willis J. Stoddard*, special chemicals dept.

****

Mr. Cord Lipe, formerly of the Minnesota Mining & Mfg. Co., has joined the Michigan Abrasive Co. as sales manager in charge of jobbers.

****

News from California

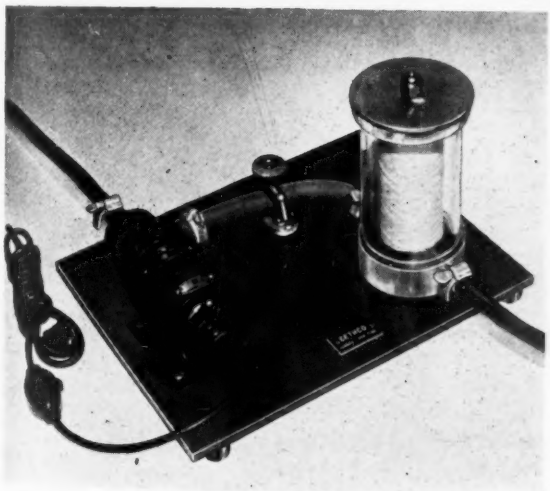
Cannon Electric Development Co., Los Angeles, reports the election of *Robert J. Cannon*, son of the company's founder, James H. Cannon, as president. The new president has been active in the firm since 1933, serving as vice-president and general manager for the past eight years. *Richard L. Rowen* was named vice-president and production manager; and *John B. Milliken*, secretary.

McColpin-Christie Corp., manufacturers of rectifiers for the plating industry and battery chargers and battery testing equipment, have completed construction on a new factory and office building at 3410 West 67th Street, Los Angeles. The company's activities were to be moved from 4922 S. Figueroa Street about the middle of August.

Victor Chemical Co., Los Angeles, manufacturers of cleaning compounds, has announced a change of name to *Jackson Chemical Co.*. *D. A. Jackson*, president, disclosed that the change was made in order to avoid conflict in identification with a company of similar name.

Pryne & Co., manufacturers of hardware specialties at Pomona, Calif., has expanded its west coast facilities by acquiring the Shelby Bicycle Co. of California and moving the machine-

SETHCO SEZ . . . Throw Away Your Funnels and Filter Paper



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- **APPLICATION** — Filters all electroplating solutions.
- **CONSTRUCTION** — High temperature lucite filter cylinder. Highest quality stainless, type 316, pump & fittings.
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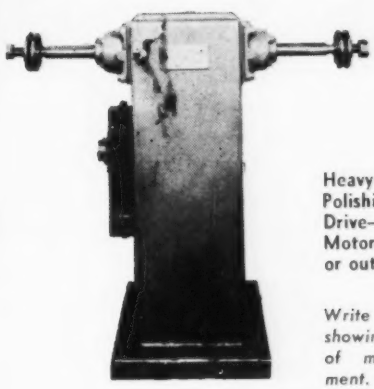

Heavy Duty Ball Bearing Polishing Machine. V Belt Drive—from 5 to 10 H.P. Motors can be either inside or outside of base.

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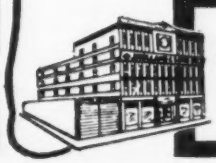

J. HOLLAND & SONS, INC.
MANUFACTURERS • DEALERS
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ry to North Pomona. The company recently opened a new hardware production plant in Newark, N. J.

G. B. Smigel, president, *Spebra Products Co.*, 2017 Granville Ave., West Los Angeles, Calif., reports that construction is underway on an addition to its plant for the production of tank linings and brewery and distillery equipment.

Arcadia Metal Products Co. reports completion of a new addition to its plant at 324 N. Second Ave., Arcadia, Calif. The firm manufactures sliding steel doors.

Other Southern California firms which have recently completed new plant additions or enlargements of metal finishing departments are the following: *Hallenscheid - McDonald Co.*, manufacturers of plumbing supplies, has arranged for additional plant space adjacent to its main plant at 1344 West Washington Blvd., Los Angeles.

Stratham Laboratories, of Beverly Hills, manufacturers of scientific instruments, is constructing a new plant and office building at 12300 West Olympic Blvd., West Los Angeles.

Calmetco, Inc., has opened an aluminum window frame assembly plant at 609 S. Anderson Street, Los Angeles, as a branch of Metal Products Corp. of Miami, Fla. *Richard S. W. Winters* has been appointed general manager of the Pacific Coast branch.

Associations and Societies

AMERICAN SOCIETY FOR METALS

Metal Show Shifts Emphasis to High Production

The importance of national security now comes first in the thinking and planning of the metalworking industry.

The year's most important meeting of this industry — the National Metal Congress and Exposition—has shifted its emphasis from the economies in production to the more realistic approach of plans, materials and equipment for high production. This shift of emphasis will enable over 350 exhibitors and 35,000 registered technical, engineering and production men to organize and properly integrate their important contributions toward the building of a national security force equal to the challenge now facing the country.

The 1950 Metal Show, to be held in Chicago during the week of October 23-27, will be one of the year's most constructive gathering together of men, materials and equipment. The "Congress", covering the technical developments in metals, both ferrous and non-ferrous, will be held in scores of meetings, lectures, forums and seminars in Chicago's downtown hotels. The International Amphitheatre will be the scene of the "Exposition", devoted to the operating and non-operating displays of materials, processes, equipment and services. Both " Con-

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TRUE BRITE NICKEL BRIGHTENER was the first nickel brightener definitely designed for barrel plating at higher speeds to match still tank bright nickel and provide for good chromium plating on racks or in barrels.

TRUE BRITE BRASS MAINTENANCE COMPOUND is the first complete brass plating compound designed to take away the headaches of off color deposits. Now available in various ratios for various brass and bronze colors.

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Complete Service for Metal Finishing

Products Listed Below Available in New York Stock With Reasonable Exceptions

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Anodes, All Kinds
Brushes
Buffs
Chemicals
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Acme White Finish
Tallow
Rouge
Emery Paste
Cleaners
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Glue
Nickel Salts
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Cyanide
Tanks, All Kinds
Plating Barrels
Polishing Wheels
Polishing Lathes

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FILTERS

MAIZO Drying Materials

LEA Buffing & Polishing PRODUCTS

gress" and "Exposition" will stress the need for high production in all phases of the industry's planning and operation.

AMERICAN SOCIETY FOR TESTING MATERIALS

Record Breaking Attendance At 1950 A.S.T.M. Annual Meeting

The 53rd Annual Meeting of the *American Society for Testing Materials* held in Atlantic City June 26 to 30 was as usual featured by a large number of technical papers and reports given in the 23 formal technical sessions, and throughout the week there were upwards of 500 meetings of the A.S.T.M. technical committees. Another interesting feature was the biennial Exhibit of Testing Apparatus and Related Equipment together with the Photographic Exhibit which featured prints, photomicrographs, and electron micrographs on engineering materials.

The registered attendance — 2134 — is a new high, exceeding the previous figure of 2064 for the 1944 Annual Meeting in New York City.

Recommendations from technical committees resulted in 68 new specifications and tests, with revisions in some 200 existing standards and tentatives. All of these will be published separately and also in the 1950 Supplement to the 1949 Book of A.S.T.M. Standards.

The Apparatus Exhibit featured many new testing and research instruments and equipment. In addition to rather complete displays of testing machines, several with newly developed features, there were many new instruments in the optical, electrical, and non-destructive testing fields.

Six long-time members of the Society, who had given especially meritorious service to it and who were of outstanding eminence in the field of engineering materials, received Honorary Memberships. These men were as follows: *Phaon H. Bates*, formerly of Washington, D. C., now St. Petersburg, Fla.; *Wilson C. Hanna*, Colton, Calif.; *Dean Harvey*, Pittsburgh, Pa.; *Prevost Hubbard*, New York, N. Y.; *Robert Job*, Montreal, Canada; and *Henry S. Rawdon*, Washington, D. C.

Three awards were made at the meeting for outstanding technical papers as follows:

Charles B. Dudley Medal — to Professor *B. J. Lazan*, Syracuse University, Syracuse, N. Y. This medal is presented for a paper of outstanding merit constituting an original contribution on research in engineering materials.

Richard L. Templin Award — to Professors *D. S. Clark* and *D. S. Wood*, California Institute of Technology, Pasadena, Calif. This award is presented for a significant paper describing new testing methods and apparatus, the purpose of the award being to stimulate research in the development of testing methods and apparatus.

Sam Tour Award — to *O. B. Ellis*, Senior Research Engineer, Armco Steel Corp., Middletown, Ohio. This award is presented for the purpose of encouraging research on the improvements and evaluation of corrosion testing methods and to stimulate the preparation of technical papers in this field.

New Officers:

L. J. Markwardt, Assistant Director, U. S. Forest Products Laboratory,

271

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If you have such an application, we suggest that you write for a sample.

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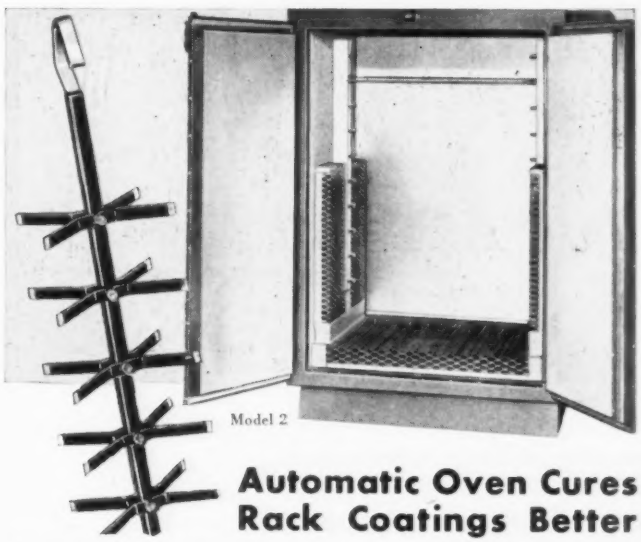

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Automatic Oven Cures Rack Coatings Better

Automatically maintains correct preheating and curing temperatures for proper coating of plating racks. Holds any temperature for which set (between 300 and 450°F.). Layout of efficient Rack Coating Department and complete information on BELKE Electric Ovens in Bulletin 1061. Ask your BELKE Service Engineer, or write.

Inside dimen.	MODEL 1	2	3
WIDE	24"	36"	48"
HIGH	48"	48"	48"
DEEP	24"	24"	24"
F.O.B. CHICAGO	$495	$605	$780

Other sizes to specifications

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EVERYTHING FOR PLATING PLANTS

Madison, Wis., was elected President for 1950-1951, succeeding *James G. Morrow*, Metallurgical Engineer, The Steel Company of Canada, Ltd., Hamilton, Ontario, who continues on the Board of Directors as Past-President for three years.

T. S. Fuller, Engineer in Charge of Works Laboratory, General Electric Co., Schenectady, N. Y., is the new Vice-President to serve with the Senior Vice-President, *F. E. Richart*, Research Professor of Engineering Materials, University of Illinois, Urbana, Ill.

COURSES IN ELECTROPLATING

Electroplating Correspondence Course

The *Joseph B. Kushner Electroplating School*, now entering its third year of successful operation, is presently accepting enrollments in its newly revised correspondence course in modern electroplating practice.

The school is licensed by the Department of Public Education of the Commonwealth of Pennsylvania and the course is recognized throughout the 48 states for vocational training in modern electroplating techniques. It is given under the direct personal supervision of *Joseph B. Kushner*, Consulting Electroplating Engineer. In accordance with the established policy of the school, *Electroplating Know How* has been revised so as to keep it abreast and ahead of the latest developments in the field. A considerable amount of new material has been added which makes it of even greater value than before to platers, foremen, plating executives and chemists.

While the course may be started at any time during the year, early fall enrollments are advised as only a limited number of students are accepted during a given time period. For complete details on *Electroplating Know How* and enrollment forms, write to the *Joseph B. Kushner Electroplating School, Dept. MF, Stroudsburg 1, Pa.*

Free Evening Course in Electroplating

An evening lecture and laboratory course in Industrial Electrochemistry and Electroplating will be given at the Brooklyn Technical High School starting in September, 1950. There will be no charge involved in taking the course, which will cover basic chemistry, electrochemical principles, chemical analysis, and practical electroplating. Emphasis will be on laboratory work, wherein the students will carry out investigations in cleaning, electrocleaning, bright plating, and plating from all the commercial baths. Field trips to commercial plating plants and lectures by guest experts are also planned.

Anyone interested in taking this free course should contact, preferably by writing, *Mr. James P. Striffler*, Brooklyn Technical High School, De-Kalb Ave. & Fort Greene Place, Brooklyn, N. Y. Early registration is suggested, as the number of persons who can be accommodated may be limited, and will be on a first come-first served basis.

Evening Courses in Electrochemical Subjects

The Graduate School of Brooklyn Polytechnic Institute will again sponsor several evening courses of interest to those engaged in electroplating and electrochemical engineering. These

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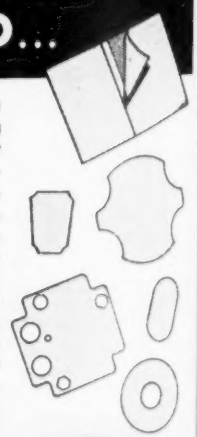

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courses will start on September 25th, and are open to graduate students and persons well qualified by industrial experience. Non-graduates are admitted on a special non-matriculated basis. The courses to be given are:

Corrosion in the Process Industries
Fee $34.00 1-term course

Electrochemical Technology
" $68.00 2-term "

These courses will both be held on Friday evenings and could be taken concurrently.

Complete information may be obtained from the Dean of the Graduate School, *Polytechnic Inst. of Brooklyn, 99 Livingstone St., Brooklyn, N. Y.*

City College to Give Electroplating Course

The College of the City of New York, School of Technology, will offer a course in *Practical Electroplating*, for the Fall Semester. The course will be given on Monday evenings from 7:00 to 9:00 p.m. Registration will be held September 19th and 21st in the evening. Course begins September 25th.

The primary objective of the course is to provide commercial electroplaters with a sound understanding of the principles underlying their work. For details, address *Prof. W. Willig*, City College, New York 31, N. Y. or phone AD 4-2000 during business hours.

Electroplating & Metal Finishing Courses at IEM

The *Institute of Electrochemistry and Metallurgy*, 59-61 East Fourth Street, New York City will again offer specialized courses in the field of electroplating and metallurgy during 1950-1951. An expanded program is planned for the coming school year with the addition of five new courses and classes being held on four evenings each week instead of two as in former years. The new courses will be Research III and IV, Analysis of Plating Solutions I and II, and Metal Finishing.

Veterans can attend the School under the G.I. Bill of Rights, and non-veterans may arrange for time payments if desired. Registration will be held from September 11 to September 14, and classes will start on September 18. The folowing courses will be offered in the Fall term:

ELECTROPLATING I.

Tuesday and Wednesday from 7:30 to 11:00 P.M. Fee, $66.00.

METALLURGY I.

Tuesday and Wednesday 8:30-9:30 P.M. Fee, $56.00.

RESEARCH I.

Tuesday and Wednesday, 7:00-11:00 P.M. Fee, $56.00.

RESEARCH III.

Prerequisite, Electroplating I and II and Research I and II or their equivalent. Seven hours per week at time to be arranged. Fee, $56.00.

ANALYSIS OF PLATING SOLUTIONS I.

Prerequisite, Electroplating I or its equivalent. Monday and Thursday, 7:00-10:00 P.M. Fee $66.00.

METAL FINISHING

This course is designed to give the student a general picture of the metal finishing field. Topics to be covered

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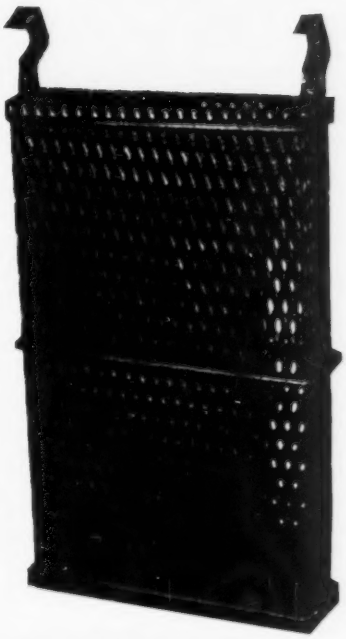

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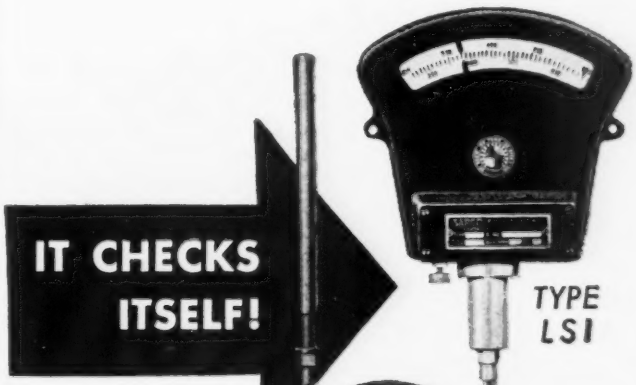

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include reasons for coating metals and non-metals, base materials used, materials used for coatings, methods of preparing the base material such as degreasing, pickling, electrocleaning, sandblasting, polishing and buffing, and methods of applying the coatings such as galvanizing, spraying, dipping, anodizing, lacquering, and electroplating. Some time will also be given to a brief discussion of metallizing plastics and a consideration of specifications for coatings. Three hours of class per week for one term at time to be arranged. Prerequisite; Electroplating I or its equivalent. Fee, $56.00.

Letters to the Editor

June International Issue

Metal Finishing
11 W. 42 St.
New York, 18, N. Y.

Gentlemen:

After all these years your good magazine has finally pulled an unpardonable error. Your account of the Boston Convention stated that you did not know who won the annual East-West baseball game.

I demand that you clean house and get a new staff of reporters to prevent a recurrence of this type of slipshod reporting in the future. In view of their ignorance of the final score, the least you could have done was to have reported that the East probably won, but that you didn't know by how much! Will you please get out a special extra giving the score as East 13-West 12?

Very truly yours,

ARTHUR W. (LIPPY LEO) LOGOZZO
Permanent Manager-East Team.

(We knew, but didn't think anyone would believe us. It's too bad for radio that the game wasn't televised. Incidentally, we hear by the grapevine that the Giants are in the market for someone with enthusiasm to replace kindly old Leo. Now that your lessened duties for the Supreme Society permit more leisure time, we wonder if you would be interested? Any manager that could coax a win out of that Eastern team could probably win the National League pennant by at least 25 games!—*Ed.*)

Mr. W. A. Raymond, Editor
Metal Finishing
11 W. 42 St.
New York, 18, N. Y.

Dear Mr. Raymond:

The article in your June issue on electroplating throughout the world was very interesting and did much to broaden my knowledge of other finishing methods. I am sure that if such a feature would appear periodically in your magazine that it would be of lasting interest to readers who want to be well informed on plating progress.

Very truly yours,

RALPH J. GREEN.

Metal Finishing
11 W. 42 St.
New York, 18, N. Y.

Gentlemen:

You are to be commended for the story of electroplating throughout the

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THROWS DOWN HEAVY METAL IMPURITIES.

REMOVES EXCESSIVE CARBONATES

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world as contained in your June 1950 International Issue. This is the first time a real picture of the electroplating industry in different countries has been published. The knowledge of what the other fellow is doing is always of interest, especially knowledge from foreign lands. We can now see how far electroplating has progressed in this country and be proud of its accomplishments.

To dedicate this issue of world plating practice to Tom Trumbour was not only a fine gesture but a well-deserved honor.

Yours truly,
GEORGE B. HOGABOOM.

Metal Finishing
11 W. 42 St.
New York, 18, N. Y.

Gentlemen:

I have just finished reading your June issue of Metal Finishing, and feel that I must write you and say what a really wonderful job you did on this International Issue.

Mr. Raymond and the others are certainly to be congratulated on as fine and complete a coverage of the world-wide plating situation as has ever been done. The men who wrote the articles knew what they were talking about and the pictures added a great deal of interest to their stories.

It is an issue to be proud of. It was not my good fortune to be able to attend the Boston convention, but I am sure that your issue must have added a great deal to the general tone and understanding of the delegates.

The tribute to Tom Trumbour was a nice and well-deserved tribute to his life-long devotion to this industry.

All in all, orchids to you and your organization for an outstanding piece of work.

Sincerely yours,
LLOYD S. BURNS.
Vice-Pres.
E. Reed Burns Mfg. Co.

Metal Finishing
11 W. 42 St.
New York, 18, N. Y.

Dear Mr. Raymond:

Just a few lines to congratulate you on your International Issue. The entire publication had a very nice appearance and you can be sure that the article about Finland and the status of electroplating there received my special attention. You have done a fine job in issuing this International Issue. Perhaps this would be a suitable method for getting countries closer together and for helping peace throughout the world. It is a good idea for other fields as well, and maybe the electroplating industry has now done the pioneer work along these lines.

With my best congratulations for the job you have done, I am with the kindest regards,

Sincerely Yours,
ERIK NORDGEN
Helsinfors, Finland.

Mr. Walter Raymond
Metal Finishing
11 West 42nd St.
New York 18, N. Y.

Dear Walter:

Just a line to compliment you on the June issue of Metal Finishing.

Byron and I consider it the most interesting we've read in a great many years.

Regards to the gang at the office.

Sincerely yours,
NATHANIEL HALL
G. B. Hogaboom, Jr. & Co.
Newark, N. J.

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54 Waltham Ave.
Springfield, Mass.

755 Vestal Avenue
San Jose, Calif.

Mr. T. A. Trumbour
Metal Finishing
New York City, N. Y.

Dear Tom:

After all these years can I still call you Tom, or should I throw my hat in first? I know close to 30 years have gone by since we have seen each other, but memories linger on.

As I look back over the years, it was in 1918 that I wrote my last article for Metal Finishing on the manufacture of phonograph records. I still have samples of electroformed work that was done before 1915. I wrote some other articles in 1915 and back in 1907 I also wrote an article on oxidized and black finishes.

Do you ever look back on other days of long ago? I wonder if any of the old timers of the old National Association are still with us? I have received no news of any of them since my letter was published in *Plating*. I guess there cannot be many of them left with us now. I still look over the pages of *Metal Finishing*. The people who run my old shop subscribe to it and I see it when I call on them to say hello.

The article on page 67 of the June, 1950 issue does not do you justice; not as I have known you in the years gone by. The children must be proud of their dad.

As for myself, I have been retired for six years and now play with the garden and am raising fancy canaries. I have done some research along biological and chemical lines, but these are just pastimes, as I must keep busy with something. I note that you have not missed a convention in all these years and wonder if you intend to keep up the record by coming to Los Angeles next year? If you do it is possible that we may meet again. Health permitting I will surely try to be there next June, and if I am I will see at least one old face I can greet, and one that will bring back pleasant memories of the days gone by. May I wish you many more years in a work that has meant so much to the plating industry. I hope to see you in Los Angeles next June. With best wishes to you and the family, I remain

Sincerely yours,

SAM HERRICK, PH.D.

P.S.—I know you don't know about those initials at the end of my name, as I have not used them since I was a consultant in New York City 40 years ago.

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